FILED
2-29-16
04:59 PM

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

Application of the California Energy Commission for Approval of Electric Program Investment Charge Proposed 2015 through 2017 Triennial Investment Plan.	A.14-04-034 (Filed April 29, 2014)
And Related Matters.	A.14-05-003 A.14-05-004 A.14-05-005

2015 ANNUAL ELECTRIC PROGRAM INVESTMENT CHARGE REPORT OF PACIFIC GAS AND ELECTRIC COMPANY (U 39 E)

CHRISTOPHER J. WARNER

Pacific Gas and Electric Company
77 Beale Street, B30A
San Francisco, CA 94105
Telephone: (415) 973-6695
Facsimile: (415) 973-0516
E-Mail: CJW5@pge.com

Attorneys for
PACIFIC GAS AND ELECTRIC COMPANY

Dated: February 29, 2016

Pursuant to Decision (D.)12-05-037 – *Phase 2 Decision Establishing Purposes and Governance for Electric Program Investment Charge (EPIC) and Establishing Funding Collections for 2013-2020*, D.13-11-025 and D.15-04-020, Pacific Gas and Electric Company (PG&E) hereby submits the 2015 Annual Report for the Electric Program Investment Charge (EPIC) Program. This is PG&E's fourth annual report pertaining to its 2012-2014 EPIC Triennial Investment Plan, and first annual report pertaining to its 2015-2017 EPIC Triennial Investment Plan. In compliance with Ordering Paragraph 16 of D.12-05-037, a copy will also be served on all parties in the most recent EPIC proceedings; the most recent general rate cases of PG&E, Southern California Edison Company (SCE), and San Diego Gas & Electric Company (SDG&E); and each successful and unsuccessful applicant for an EPIC funding award during the previous calendar year.

The Annual Report is attached as Attachment A.

Respectfully Submitted,

CHRISTOPHER J. WARNER

By: */s/ Christopher J. Warner*
CHRISTOPHER J. WARNER

Pacific Gas and Electric Company
77 Beale Street, B30A
San Francisco, CA 94105
Telephone: (415) 973-6695
Facsimile: (415) 973-0516
E-Mail: CJW5@pge.com

Attorney for
PACIFIC GAS AND ELECTRIC COMPANY

Dated: February 29, 2016

ATTACHMENT A

PACIFIC GAS AND ELECTRIC COMPANY

ELECTRIC PROGRAM INVESTMENT CHARGE (EPIC)
2015 ANNUAL REPORT

FEBRUARY 29, 2016

Pursuant to Decision (D.) 12-05-037 – Phase 2 Decision Establishing Purposes and Governance for Electric Program Investment Charge (EPIC) and Establishing Funding Collections for 2013-2020, Pacific Gas and Electric (PG&E) hereby files the 2015 Annual Report for the Electric Program Investment Charge Program.

In compliance with Ordering Paragraph 16, a copy will also be served on all parties in the most recent EPIC proceedings; the most recent general rate cases of PG&E, Southern California Edison Company (SCE), and San Diego Gas & Electric Company (SDG&E); and each successful and unsuccessful applicant for an EPIC funding award during the previous calendar year.

Service Lists - A.12-11-001, A.12-11-002, A.12-11-003, A.12-11-004, A.15-09-001, A.13-11-003, A.14-11-003, A.14-05-005, A.14-05-003, A.14-05-004, A.14-04-034

Table of Contents

List of Tables

1. Executive Summary

a. Overview of Programs/Plan Highlights

Pursuant to the California Public Utilities Commission (CPUC) Decision (D.) 12-05-037, Pacific Gas and Electric Company (PG&E) and the other administrators of the Electric Program Investment Charge (EPIC) Program were directed to file annual reports each year beginning February 28, 2013 through February 28, 2020 with the Director of the CPUC's Energy Division.[1] Annual Reports shall be served on all parties in the most recent EPIC proceeding; all parties to the most recent general rate case of each electric utility; and each successful and unsuccessful applicant for an EPIC funding award during the previous calendar year. In compliance with Ordering Paragraph (OP) 16 of D.12-05-037, and consistent with the Annual Report outline developed collaboratively by the EPIC Administrators and the Office of Ratepayer Advocates[2], PG&E files its fourth annual report, documenting activities from January 1 through December 31, 2015.

In D.12-05-037, the Commission authorized funding in the areas of applied Research and Development (R&D), Technology Demonstration and Deployment (TD&D), and Market Facilitation. The Investor-Owned Utility (IOU) Administrators' role was limited to TD&D only. On November 19, 2013, the CPUC issued D.13-11-025, which authorized the first triennial investment period of 2012-2014 (referred to as EPIC 1). On April 15, 2015, the CPUC issued D.15-04-020, which approved the second triennial investment plan period of 2015-2017 (referred to as EPIC 2). This report summarizes PG&E's projects' progress and status for both approved funding cycles, which includes projects in progress in the following areas:

1. **Renewables and Distributed Energy Resource Integration** – Integrate distributed energy resources, generation and store; improve transparency of resource information; increase generation flexibility.
2. **Grid Modernization and Optimization** – Optimize existing grid assets; prepare for emerging technologies; design and demonstrate grid operations of the future.
3. **Customer Service and Enablement** – Drive customer service excellence by leveraging PG&E's SmartMeter™ platform and offering greater billing flexibility; integrate Demand-Side Management (DSM) for grid optimization.
4. **Cross Cutting/Foundational Strategies and Technologies** – Support next generation infrastructure, including smart grid architecture, cybersecurity, telecommunications and standards, as well as other "foundational" activities in support of all three program areas above.

PG&E is enthusiastically committed to the EPIC program and the value it provides to our customers, as it offers the opportunity to test innovation within our network, as well as at the grid edge. In addition to contributing to the areas described above, PG&E's EPIC projects also provide important contributions to enhancing areas tied to our core values of providing safe, reliable and affordable energy for our customers. Furthering advancement in technologies that support our core values and continuing to test innovation for an evolving grid align closely with PG&E's Grid of Things™ strategy. The Grid of Things™ vision integrates new energy devices and technologies with the grid and allows their owners to achieve greater value from their energy technology investments – rooftop solar, electric vehicles (EVs), energy storage, demand

[1] The four EPIC program administrators are PG&E, Southern California Edison Company (SCE), San Diego Gas & Electric Company (SDG&E) and the California Energy Commission (CEC).

[2] This annual report outline is based on adopted EPIC Administrator Annual Report Outline as described in Attachment 5 of D.13-11-025.

response technologies, etc. – by virtue of their grid connectivity. PG&E is the key builder and enabler of this interconnected and integrated platform that will help define California's future energy landscape.

PG&E's TD&D Program Highlights

With CPUC approval of EPIC 2 in D.15-04-020, PG&E has added 16 active EPIC 2 projects to the EPIC portfolio, increasing the Portfolio from 17 EPIC 1 projects to a total of 33 currently approved projects across both EPIC 1 and EPIC 2. For detailed information on the developments and status of each project, see Appendix A.

PG&E continues to make significant progress within its portfolio of EPIC projects. In the first triennial cycle, PG&E's EPIC 1 portfolio covered the wide spectrum of technologies that helps make the electrical grid safer, more reliable and more affordable. In a number of instances, this was achieved through the following:

- Testing physical devices, like robots that help perform maintenance on potentially dangerous switches
- Demonstrating viability of grid-supporting trucks that can keep an American Red Cross facility functioning during a wildfire or a planned outage
- Drawing together diverse data sources to give grid operators a more complete perspective to optimize operations with situational intelligence
- Providing customers online access to their estimated solar generation data that has not been previously available to them.

EPIC 1 represented PG&E's ability to adopt a new model for managing, aligning, and tracking research, development and demonstration (RD&D) projects across disparate areas of the grid.

In the second triennial cycle, PG&E's EPIC 2 portfolio builds on the capabilities and organization established in EPIC 1, with an even deeper focus on long-term objectives. Many of our projects will lay the foundation for future capabilities, such as the creation of algorithms that can determine the phase of current being carried by a given power line, or explore the integration challenges of managing Distributed Energy Resources (DERs). These projects reinforce one another, and are increasingly being piloted in shared geographies to take advantage of benefits that are more than the sum of their parts.

As an innovative and integrated way to execute technology demonstration projects, PG&E's EPIC program continues to improve the safety, reliability and affordability of the electric grid, while building integration and cross-dependencies from the ground up. These achievements help prepare PG&E (and the utility industry) for upcoming challenges of a changing grid landscape.

In 2015, the first EPIC 1 project was completed: Project 1.08 Distribution System Safety and Reliability through New Data Analytics Techniques. This project's final report is attached in Appendix B, with details including but are not limited to a comprehensive review of the project, detailed findings and results.[3]

The following report details the progress made within PG&E's EPIC portfolio in 2015 and below are a few major milestones achieved to date for select EPIC projects:

[3] As specified in D.13-11-025 OP 14, Administrators must include with their EPIC annual report a final report on project completed during the previous year.

Project 1.01 - Energy Storage for Market Operations leverages the existing two megawatt (MW) PG&E Vaca Dixon Battery Energy Storage System (BESS) and the 4 MW Yerba Buena BESS. In 2014, the energy storage pilot successfully bid as an available energy resource into the California Independent System Operator (CAISO) Non-Generator Resource (NGR) day-ahead market on a manual basis. Due to the unique nature of an energy storage resource, the 2 MW storage facility offers 4 MW of flexibility to the system, since it can serve as both load and generation. This puts energy storage at a competitive advantage compared to traditional generation. In 2015, Vaca Dixon BESS effectively followed real-time dispatches from CAISO, which is the first time in PG&E history that a resource on the Operational Data Network has successfully received and executed CAISO market awards on an automated basis. This now allows Vaca Dixon to participate in the five-minute, real-time market, making the storage resource even more flexible in meeting the dynamic needs of the grid of the future. PG&E anticipates rolling out similar automated functionality with its 4 MW Yerba Buena BESS in 2016.

Project 1.08 - Distribution System Safety and Reliability through New Data Analytics Techniques (also known as System Tool for Asset Risk (STAR)) was successfully completed by demonstrating a visualization tool that calculates asset risk based on an integrated data set from different sources. The successful demonstration of STAR can improve public safety by identifying and addressing higher risk assets, reducing unplanned outages and customer interruptions and supporting asset planning that can help avoid unneeded equipment replacements because of better information.

Project 1.09A - Close Proximity Switching successfully tested three new, safety-focused devices and varied techniques to operate underground oil-filled switches remotely, including the parts and adapters necessary to support various types of switches. These devices are expected to help lower the hazard level when oil filled switches are operated in the field. The project has helped drive the market to satisfy an unmet need and is resulting in future planned orders of these devices beyond the scope of this project.

Project 1.16 - Vehicle-to-Grid Operational Integration developed multiple test vehicles that can export up to 120 kilowatt (kW) of power to the grid, providing temporary power for customers during planned or unplanned outages. During the summer of 2015, the prototype trucks supported the Valley and Butte fire response. These vehicles successfully generated power for two days at a Red Cross shelter and a local church for housing evacuees, which was a cleaner and quickly deployable alternative to the traditional gas-burning generators.

Project 1.19 - Enhanced Data Techniques and Capabilities via the SmartMeter™ Platform explores the effective SmartMeter™ data that can be collected and studied for further grid benefits. In 2015, the project demonstrated that, by collecting and analyzing interval voltage and usage data from SmartMeters™, PG&E can detect energy diversion cases and use that information to remediate safety hazards and prevent unnecessary load loss.

Project 1.23 – Photovoltaic (PV) Submetering effectively deployed estimated generation data for 10,000 solar customers through the PG&E “My Energy” website. This was an important step on the path to providing solar customers further insight into their approximate generation data, since solar customers currently only have access to their net energy usage.

Project 2.23 – Integrating Distributed Energy Resources (DERs) into Utility Planning Tools has successfully combined available SCADA load information data with 3 years of historical interval meter data for all 5 million PG&E electric customers and created a catalog of over 320,000 load shapes, which creates a granular load shape, specific to each feeder.

a. Status of Programs

In D.13-11-025, the Commission approved 27 of the 29 projects proposed by PG&E in the EPIC 1 Plan since two projects were formally withdrawn by PG&E prior to the issuance of this decision.[4] In D.15-04-020, the Commission approved 31 projects proposed by PG&E in the EPIC 2 Plan.[5] PG&E has implemented an internal governance structure intended to ensure that approved projects within the TD&D program adhere to the EPIC guiding principles and requirements, as well as the potentially changing marketplaces and evolving technologies. Of the 27 CPUC-approved EPIC 1 projects, PG&E continues to be actively engaged in 17. These 17 projects are in the following phases as of December 31, 2015: zero project are in the Plan/Analyze Phase; four projects are in the Design/Engineering Phase, eight projects are in the Build/Test Phase, one project is in the Staging Phase, three projects are in the Closeout Phase and one is complete. The ten projects that were on hold at the end of 2014 have remained on hold in 2015. As previously indicated in the 2014 PG&E EPIC Annual Report, PG&E may utilize remaining funds by either adding funding to active projects or pursuing on hold projects.

Of the 31 CPUC-approved EPIC 2 projects, PG&E is actively engaged in 16 of them as of December 31, 2015. These 16 projects are in the following phases as of December 31, 2015: fifteen are in the Plan/Analyze Phase and one is in the Build/Test Phase.

Below is a table that summarizes the projects' funding status by area and program cycle.

[4] In the EPIC 1 Plan Application (A.12-11-003), PG&E originally proposed 26 projects. Project 1.09 was subsequently split into three projects and project 1.10 was split into two projects resulting in a total of 29 projects. The projects formally withdrawn by PG&E were projects 1.04 and 1.07.

[5] In the EPIC 2 Plan Application (A.14-05-003), PG&E originally proposed 30 projects. Per the CPUC D.15-04-020 to include an assessment of the use and impact of EV energy flow capabilities, Project 2.3 was split into two projects, resulting in a total of 31 projects.

Table 1. Summary of Project Status and Funding by Program Cycle

	EPIC 1	EPIC 2	Total
Renewables and DER Integration	• 3 Projects (Projects: 1.01, 1.02, 1.05) funded as of December 31, 2015. • Committed Funding Range: $7.0 – $8.5 million.	• 5 Projects (Project: 2.02, 2.3A, 2.3B, 2.04, 2.06) funded as of December 31, 2015. • Committed Funding Range: $9.6 -$12.6 million.	• 8 Total Projects • Committed Funding Range: $22.1 -$27.0 million.
Grid Modernization and Optimization	• 7 Projects (Projects: 1.08, 1.09A, 1.09B/10B, 1.09C, 1.14, 1.15, 1.16) funded as of December 31, 2015. • Committed Funding Range: $16.9 – $20.7 million	• 4 Projects (Projects: 2.07, 2.10, 2.14, 2.15) funded as of December 31, 2015. • Committed Funding Range: $5.7 - $7.0 million.	• 11 Total Projects • Committed Funding Range: $25.1 -$30.7 million.
Customer Service and Enablement	• 7 Projects (Projects: 1.18, 1.19, 1.21, 1.22, 1.23, 1.24, 1.25) funded as of December 31, 2015 • Committed Funding Range: $11.0 - $13.5 million	• 4 Projects (Projects: 2.19, 2.21, 2.22, 2.23) funded as of December 31, 2015. • Committed Funding Range: $6.9 - $8.5 million.	• 11 Total Projects • Committed Funding Range: $13.0 -$17.1 million.
Cross Cutting/ Foundational	• 0 Projects	• 3 Projects (Projects: 2.26, 2.27, 2.29) • Committed Funding Range: $4.5 - $5.5 million	• 3 Projects (Projects: 2.26, 2.27, 2.29) • Committed Funding Range: $4.5 - $5.5 million.
Summary	• *Total Funded Projects:* 17 • *Total Project Funding Encumbered:* $19.5 million • **Total Committed Funding:* $34.9 -$42.7 million • Total Project Funding Spent to Date: $24.0 million • Total Administrative Costs Spent to Date: $1.6 million	• *Total Funded Projects:* 16 • *Total Project Funding Encumbered:* $2.7 million • **Total Committed Funding:* $26.7 -$33.5 million • Total Project Funding Spent to Date: $1.8 million • Total Administrative Costs Spent to Date: $0.2 million	• *Total Funded Projects:* 33 • *Total Project Funding Encumbered:* $22.1 million • **Total Committed Funding:* $61.6 - $76.2 million. • Total Project Funding Spent to Date: $25.8 million • Total Administrative Costs Spent to Date: $1.8 million

** Committed projects are refined through an internal governance, stage-gate approach, in order to manage committed funding. Remaining funds may, as needed, either be redirected to other approved projects in order to efficiently utilize customer funds.*

2. Introduction and Overview

a. Background on EPIC

Funding for EPIC is authorized in Public Utilities Code (PUC) Section 399.8, which governed the Public Goods Charge (PGC) until expiration on January 1, 2012. The Commission opened an Order Instituting Rulemaking (R.11-10-003) to establish the Electric Program Investment Charge to preserve funding for the public ratepayer benefits associated with the renewables and RD&D activities provided by the electric PGC. The rulemaking included two phases with Phase I to establish the EPIC program on an interim basis in 2012, and Phase II to establish purposes and governance for EPIC to continue from 2013-2020.[6] The EPIC program administrators include three IOUs – PG&E, SCE and SDG&E – and the CEC.

In its Phase I *Decision Establishing Interim Research, Development and Demonstrations and Renewables Program Funding Levels* (D.11-12-035), the CPUC established 2012 funding at approximately $142 million and authorized PG&E, SCE and SDG&E to institute the EPIC program, effective January 1, 2012, to collect funds for renewables programs, and Research, Development and Demonstration (RD&D) programs at the same level authorized in 2011. Additionally, the surcharge was imposed on all distribution customers, based on the existing rate allocation between customer classifications, and collected in the Public Purpose Program component of rates.

On May 24, 2012, the Commission issued its Phase II *Decision Establishing Purposes and Governance for Electric Program Investment Charge and Establishing Funding Collections for 2013-2020*. The decision established an annual funding amount of $162 million annually for the 2012-2014 EPIC program cycle (EPIC 1) and set the funding allocations among the three IOUs as 50.1 percent, 41.1 percent and 8.8 percent for PG&E, SCE and SDG&E, respectively.[7] On April 15, 2015, the CPUC issued D.15-04-020, which approved the second triennial investment plan period of 2015-2017 (EPIC 2).

The EPIC program is designed to assist the development of pre-commercialized, new and emerging clean energy technologies in California, while providing assistance to commercially viable projects. The goal of the EPIC programs is to support projects that help advance new technologies that further safety, reliability and affordability while advancing California's clean energy goals, including Senate Bill 17 Smart Grid Goals and PUC Section 740.1 goals focused on renewables integration and resource conservation, as well as greenhouse gas emissions reductions, economic development and low-emission vehicle and transportation support. EPIC supported activities are mapped to the different elements in the electricity-system value chain consisting of: Grid Operations/Market Design, Generation, Transmission, Distribution and Demand-Side Management (DSM).

b. EPIC Program Components

Authorized by D.12-05-037, the EPIC Program is to fund investments in the following three areas: (1) Applied Research and Development; (2) TD&D; and (3) Market Facilitation, consisting of market research, regulatory permitting and streamlining, and workforce development activities. PG&E and the other IOU Administrators were designated to administer EPIC funds only in the area of TD&D. The CEC was designated to administer funds in all of the remaining areas, including a portion of TD&D.

[6] See Phase I D.11-12-035 and Phase II D.12-05-037.

[7] OP 7 of D.12-05-037 requires the total collection amount to be adjusted on January 1, 2015 and January 1, 2018 commensurate with the average change in the Consumer Price Index for Urban Wage Earners and Clerical Workers for the third quarter, for the previous three years.

c. EPIC Program Regulatory Process

The Phase II decision provides the regulatory process and governance for the EPIC program. The decision requires EPIC Program Administrators to submit Triennial Investment Plans to cover three-year cycles for 2012-2014, 2015-2017, and 2018-2020. The investment plans must include details about planned investments, as well as criteria for selecting and evaluating proposals. Each plan must be evaluated and approved by the Commission prior to program implementation. To date, Administrators have filed two Triennial Investment Plans for 2012-2014 and 2015-2017. In addition, Administrators are required to file annual reports on February 28, 2013 through February 28, 2020, as well as final reports for each project.

d. Coordination

In order to ensure adequate coordination of the EPIC Program, the EPIC Administrators continue to participate in regular review meetings, conduct joint webinars and workshops, and regularly collaborate on EPIC-related matters. The IOU EPIC Administrators generally meet biweekly to discuss EPIC and their respective objectives for the program, as well as to ensure collaboration and avoid duplication. The Administrators work together to leverage consistent approaches, where feasible, for meeting the objectives of the EPIC Program. This collaboration resulted in the development of a common EPIC framework, approved by the Commission in D.13-11-025, to guide the individual investment plans.

e. Transparent and Public Process

The program's administrators hold stakeholder workshops during the planning and implementation of the EPIC Triennial Investment Plans to ensure stakeholder concerns and feedback are received and properly addressed.

In the meantime, administrators continue to engage with industry stakeholders by participating in and presenting at conferences, as well as hosting two workshops/symposiums annually. In 2015, EPIC Administrators jointly organized a workshop in San Diego, CA on August 18, 2015 and a Symposium on December 3rd, 2015 in Folsom, CA, which consisted of three-tracks: Energy Efficiency, Generation and Integration, and Data Analytics and Systems Architecture. These workshops have provided a successful mechanism to engage with industry stakeholders and bring transparency to the projects and program.

Notice for these events is provided to a broad range of stakeholders including technology vendors, researchers, academics and energy consultants. The utilities and the CEC will continue to maintain transparency in the process via webinars, workshops and discussion with the CPUC.

PG&E's EPIC program continues to remain accessible to the interested public. PG&E's website includes EPIC program information and updates, as well as EPIC annual reports and project final reports.[8]

[8] www.pge.com/epic

3. Budget

a. Authorized Budget

The following table outlines the total Program, Administrative and CPUC regulatory oversight budget for each triennial cycle.

Table 2. Total Authorized Budget by Program Cycle

Total Authorized Budgets	PG&E Program Budget *(TD&D only)*	PG&E Admin. Budget *(TD&D only)*	CEC Program Budget* *(TD&D, Applied R&D, & Market Facilitation)*	CEC Admin Budget* *(TD&D, Applied R&D, & Market Facilitation)*	CPUC Regulatory Oversight Budget
EPIC 1: 2012-2014	$43.3 million	$4.9 million	$166.1 million	$18.5 million	$1.2 million
EPIC 2: 2015-2017	$45.7 million	$5.1 million	$183.9 million	$20.4 million	$1.3 million

**portion remitted by PG&E*

b. Commitments[9]/Encumbrances[10]

The following table outlines the PG&E total financial commitments and encumbrances, as well the remittances made to both the CEC and CPUC beginning from program inception through December 31, 2015.

Table 3. Total Commitments/Encumbrances by Program Cycle

Commitments/ Encumbrances	PG&E Total Commitments	PG&E Total Encumbrances	CEC Program Remittance	CEC Admin Remittance	CPUC Remittance
EPIC 1: 2012-2014	$34.9 - $42.7 million	$21.0 million	$91.8 million	$18.5 million	$1.2 million
EPIC 2: 2015-2017	$26.7 - $33.5 million	$2.7 million	$0 million	$6.1 million	$0.4 million

[9] Per CPUC D. 13-11-025, “committed funds” are monies budgeted for a particular project. The committed fund range is defined as project approved through PG&E’s internal governance process.

[10] Per CPUC D. 13-11-025, “encumbered funds” refer to monies specified within contracts signed during a previous triennial investment plan cycle and associated with specific activities under that contract.

c. Dollars Spent on In-House Activities

The following table outlines the PG&E total in-house project expenditures and administrative costs, beginning from program inception through December 31, 2015.

Table 4. Total Dollars Spent on In-House Activities by Program Cycle

Program Cycle	PG&E In-House TD&D Project Expenditures	PG&E In-House Program Administrative Costs
EPIC 1: 2012-2014	$9.2 million	$0.8 million
EPIC 2: 2015-2017	$0.3 Million	$0.2 million

d. Fund Shifting Above 5 Percent between Program Areas

All PG&E projects are within TD&D; therefore, there has been no fund shifting between program areas.

e. Uncommitted/Unencumbered Funds[11]

Projects without committed funding are pending further project and benefits analysis. The range of uncommitted funds is dependent on the range of authorized budget and committed funds as identified in Sections 3a and 3b, respectively. The following tables outlines the PG&E uncommitted/unencumbered funding for each program cycle as of December 31, 2015.

Table 5. Total Uncommitted/Unencumbered Funds by Program Cycle

Program Cycle	Uncommitted/Unencumbered Project Funds
EPIC 1: 2012-2014	$0.6 million – $8.4 million
EPIC 2: 2015-2017	$12.2 million – $19.0 million

4. Projects

a. Summary of Project Funding

For a summary of project funding please refer to Table 1 in Section 1b.

b. Project Status Report (*See* Appendix A)

See Project Status Report, Appendix A, with project details as of December 31, 2015. The Project Status Report is based on the format provided in Attachment 6 of D.13-11-025.

c. Description of Projects

The project descriptions for both EPIC 1 and EPIC 2 projects, provided below, are as of December 31, 2015. Projects that are on-hold have been included in the summary.

[11] "Uncommitted" and "Unencumbered" funds refer to monies that are not identified in solicitation plans or obligated to a particular project – these funds are considered unspent.

Project #1.01 – Energy Storage for Market Operations

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Grid Operation/Market Design

iii. Objective
- Develop technologies and strategies for efficient and optimized bidding and scheduling of Energy Storage Technologies (ESTs) in California ISO markets and demonstrate those strategies using PG&E's existing Sodium Sulfur Battery Energy Storage Systems (NaS BESS).
- This project contributes to objectives in the following CPUC proceeding(s): Energy Storage OIR R.15-03-011.

iv. Scope
- Develop and deploy technology to enable fully automated resource response to CAISO market awards.
- Quantify the values that battery resources can capture in CAISO markets.
- Inform Cost Effectiveness Models.
- Provide Guidance on Regulatory Compliance.

v. Deliverables
- Demonstrate automated and remote control application for generic energy storage resources to interface with existing SCADA systems.
- Report financial performance from participation in CAISO markets.
- Report comparison of actual performance vs. hypothetical performance quoted in industry reports.
- Comply with regulatory requirements and establish a framework/recommendations for accounting standards applicable to energy storage.

vi. Metrics
- 3a - Maintain/Reduce operations and maintenance costs.
- 7b - Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (PU Code § 8360);
- 7h - Deployment and integration of cost-effective advanced electricity storage and peak-shaving technologies, including plug-in electric and hybrid electric vehicles, and thermal-storage air conditioning (PU Code § 8360)
- 9c - EPIC project results referenced in regulatory proceedings and policy reports (Business Plan references: CPUC Rulemaking 10-12-007) - this project would provide data to understand the cost-effectiveness of battery storage.

vii. Schedule
- 2.5 years

viii. EPIC Funds Encumbered
- $616,287

ix. EPIC Funds Spent
- $1,635,137

x. Partners

- Partnered with Energy Regulators Regional Association (ERRA) to leverage battery assets, software and expertise.
- Partnered with California Independent System Operator (CAISO) to deploy first energy storage asset in Non-Generator Resource market and provided feedback for software improvements.

xi. Match Funding

- N/A

xii. Match Funding Split

- N/A

xiii. Funding Mechanism

- Pay for performance

xiv. Treatment of Intellectual Property

- N/A - No current evidence of IP development

xv. Status Update

- Project is in Build/Test phase.
- Deployed and demonstrated primary technological goal of this project - PG&E Vaca Dixon Battery Energy Storage Systems followed CAISO market awards automatically.
- Next steps are to execute automatic bidding into CAISO market with PG&E's Battery Energy Storage System at Yerba Buena, and continue bidding the Vaca Dixon battery resource into CAISO markets up to project closeout.

Project #1.02 – Energy Storage for Distribution Operations

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Distribution; Grid Operation/Market Design

iii. Objective
- Demonstrate the ability of a utility operated energy storage asset to address capacity overloads on the distribution system and improve reliability.
- This project contributes to objectives in the following CPUC proceeding(s): Energy Storage OIR: R.15-03-011.

iv. Scope
- Deploy utility operated energy storage asset at a single site
- Demonstrate peak shaving use case along with other site-specific use cases as suggested by distribution operators

v. Deliverables
- Identify energy storage site based on project objectives
- Identify an economic modeling tool to compare the planned traditional utility with alternatives using distributed resources or demand-side investments
- Construct and integrate energy storage system
- Test system and analyze results to prove project objectives

vi. Metrics
- 1c - Avoided procurement and generation costs.
- 7b - Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (PU Code § 8360);
- 7d - Deployment and integration of cost-effective distributed resources and generation, including renewable resources (PU Code § 8360).
- 9c - EPIC project results referenced in regulatory proceedings and policy reports (Business Plan references: Deferring a capacity upgrade has been identified as a key potential value of energy storage technologies (ESTs) and noted in filings with the CPUC / AB 2514.

vii. Schedule
- 2.5 years

viii. EPIC Funds Encumbered
- $2,039,117

ix. EPIC Funds Spent
- $429,244

x. Partners
- No

xi. Match Funding
- No

xii. Match Funding Split

- N/A

xiii. Funding Mechanism

- Pay for Performance

xiv. Treatment of Intellectual Property

- N/A - No current evidence of IP development

xv. Status Update

- Project is in Design/Engineering Phase.
- Identified project site, developed and successfully administered a Request for Proposal (RFP) for project Engineering, Procurement and Construction (EPC) services, signed an EPC contract for 500kW/4 hour lithium-ion battery installation, and initiated electrical and civil design work.
- Next steps are to finalize designs, mobilize site, and prove use case.

Project #1.03 – Mobile and Stationary Energy Storage Synergies

i. Investment Plan Period
- 1st Triennial (2012-2014).

ii. Assignment to Value Chain
- Grid Operation/Market Design

iii. Objective
- The project aims to reduce existing barriers to deployment of battery energy storage systems by demonstrating whether post-electric vehicle (EV) “second life” batteries can cost-effectively perform electric distribution services. The project will demonstrate the potential for reduced energy storage system costs via a) the development of an integration platform for deploying such batteries (Phase I) and b) the use of lower cost “second life” batteries in the integrated platform (Phase 2).

iv. Scope
- Project scope being further evaluated - TBD

v. Deliverables
- Project deliverables being further evaluated - TBD

vi. Metrics
- TBD

vii. Schedule
- Project schedule being further evaluated - TBD

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners
- TBD

xi. Match Funding
- TBD

xii. Match Funding Split
- TBD

xiii. Funding Mechanism
- TBD

xiv. Treatment of Intellectual Property
- TBD

xv. Status Update
- Project is currently on-hold.

Project #1.04 – Expand Test Lab and Pilot Facilities for New Energy Storage Systems

Formally Withdrawn. CPUC A.12-11-003, 10/15/2013.

Project #1.05 – New Forecast Methods for Improved Storm Damage Modeling

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Distribution

iii. Objective
- Demonstration of emerging capabilities in mesoscale modeling to provide more granular and accurate weather forecasting input to PG&E's storm damage prediction model, and to other PG&E forecasting applications, like catastrophic wildfire risk and PV generation. The main goal is more effective and granular damage prediction, and therefore more efficient response to storm events.

iv. Scope
- Project focus is on development, deployment, and implementation of an operational version of the Weather Research and Forecasting (WRF) mesoscale model to support PG&E's forecasting program.
- Not in scope for this project is enhancements to PG&E's Restoration Work Plan other than improved forecast damage numbers.

v. Deliverables
- Fully functional mesoscale modeling system known as POMMS (PG&E Operational Mesoscale Modeling System) that will provide the following:
- Detailed weather input into PG&E's damage prediction modeling system (SOPP).
- Next generation wildfire threat awareness system.
- Historical and forecast solar irradiance data to internal PG&E stakeholders.

vi. Metrics
- 3a - Maintain/Reduce operations and maintenance costs.
- 4a - GHG emissions reductions (MMTCO2e)
- 5c - Forecast accuracy improvement
- 5e - Utility worker safety improvement and hazard exposure reduction

vii. Schedule
- 3.25 years

viii. EPIC Funds Encumbered
- $461,340

ix. EPIC Funds Spent
- $424,434

x. Partners (if applicable)
- Partnered with the National Forest Service and the Geographic Area Coordination Center (GACC) to obtain feedback on fire danger model.

xi. Match Funding (if applicable)
- N/A

xii. Match Funding Split (if applicable)
- N/A

xiii. Funding Mechanism (if applicable)

- Pay for performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A - No current evidence of IP development

xv. Status Updates

- Three use cases are in different Phases: Use Case 1 (Improved Damage Modeling) is in Staging Phase; Use Case 2 (Improved Fire Weather Awareness) is in Build/Test Phase. Use Case 3 (Solar Irradiance Data Use) is in Design/Engineering Phase.
- Detailed weather forecast data from POMMS improved storm damage modeling in Electric Operations, improving storm response performance - this will continue through 2016 El Nino season.
- Algorithm allowed POMMS output to a fire danger model -National Fire Danger Rating System and shared with broader fire science community.
- Working to develop PG&E Fire Index ratings and make operational in pilot system for 2016 fire season.

Project #1.06 – Demonstrate Communication Systems Allowing the California Independent System Operator Corporation to Utilize Available Renewable Generation Flexibility

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Grid Operation/Market Design

iii. Objective
- This project would demonstrate the use of accepted communications protocols to allow the CAISO to send an operating signal to reduce output under specified conditions, as allowed by contracts.

iv. Scope
- Project scope being further evaluated – TBD

v. Deliverables
- Project deliverables being further evaluated – TBD

vi. Metrics
- N/A

vii. Schedule
- Project schedule being further evaluated – TBD

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- N/A

xi. Match Funding (if applicable)
- N/A

xii. Match Funding Split (if applicable)
- N/A

xiii. Funding Mechanism (if applicable)
- N/A

xiv. Treatment of Intellectual Property (if applicable)
- N/A - No current evidence of IP development

xv. Status Updates
- Project is currently on-hold.

Project #1.07 – Demonstrate Systems to Ramp Existing Gas-Fired Generation More Quickly to Adapt to Changes in Variable Energy Resources Output

Formally Withdrawn. CPUC A.12-11-003.

Project #1.08 – Distribution System Safety and Reliability through New Data Analytics Techniques

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Transmission; Distribution

iii. Objective
- Develop and demonstrate a new data analytics technique to improve distribution system safety and reliability. The project specifically developed and tested a System Tool for Asset Risk (STAR), which is an enterprise software application that Electric Operations will use to calculate and display (graphically and geospatially) risk scores for electric transmission, substation and distribution assets. The STAR will enable an automated, system-wide application to improve risk identification, prioritization, and investment decisions to support electric system safety.

iv. Scope
- Demonstrate whether the ever-increasing amounts of data can be mined and combined for targeted, cost-effective use for improved asset management.
- Potential scenarios include risk-based asset management, safety hazard mitigation and proactive outage prediction using self-serve and virtual integration environments.

v. Deliverables
- Overview of existing applications and data sources
- Assessment of existing data source quality
- High-level future business processes by functional area
- Inventory of asset risk algorithms (formulas or complexity) for “In Scope” asset classes
- High-level Change Management Approach
- Prioritized and phased implementation plan
- Cost estimate for full implementation of the STAR project
- Proof of concept prototype

vi. Metrics
- 7c - Dynamic optimization of grid operations and resources; including appropriate consideration for asset management and utilization of related grid operations and resource, with cost-effective full cyber security (PU Code §8360)
- 3a - Maintain/Reduce operations and maintenance costs: With the improved understanding of risk, there could be a better tool for evaluating projects such as asset replacement.

vii. Schedule
- 2.25 years

viii. EPIC Funds Encumbered
- $1,249,505

ix. EPIC Funds Spent
- $2,112,640

x. Partners (if applicable)
- N/A

xi. Match Funding (if applicable)
- N/A

xii. Match Funding Split (if applicable)
- N/A

xiii. Funding Mechanism (if applicable)
- Pay for performance

xiv. Treatment of Intellectual Property (if applicable)
- N/A - No current evidence of IP development

xv. Status Updates
- Project is complete.
- Finalized asset risk score algorithm, as well as visualization and decision support system prototype.
- Completed user training and testing and evaluation.
- Project close report finalized and attached to annual report.

Project #1.09A – Close Proximity Switching

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Transmission; Distribution

iii. Objective
- This project explores and seeks to discover effective, new tools to safely operate "Solid Blade in Oil Rotatory Switches."

iv. Scope
- Test new tools and techniques for safe operation of Solid Blade in Oil Rotatory Switches.
- Evaluate alternatives to decrease probability of injury to workers and public.
- Help design a robotic tool to allow remote operation.
- Develop the necessary parts/adaptors to be used on various types (manufacturer, brand, age, etc.) of Solid Blade in Oil Rotatory Switches.

v. Deliverables
- A working prototype for the various Solid Blade in Oil Rotatory Switch tools.

vi. Metrics
- 5a - Outage number, frequency and duration reductions.
- 5e - Utility worker safety improvement and hazard exposure reduction

vii. Schedule
- 2.5 years

viii. EPIC Funds Encumbered
- $301,808

ix. EPIC Funds Spent
- $495,333

x. Partners (if applicable)
- N/A

xi. Match Funding (if applicable)
- N/A

xii. Match Funding Split (if applicable)
- N/A

xiii. Funding Mechanism (if applicable)
- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)
- TBD

xv. Status Updates
- Project is in Close-out Phase.
- Completed testing of robotic arm prototype from 3 vendors, and created benefits/weaknesses guidance, which will be shared with the wider IOU community. Next steps are to complete final report.

Project #1.09B and 1.10B – Network Conditioned-Based Maintenance

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Transmission; Distribution

iii. Objective
- The project focus is on development, testing, deployment, and implementation of new technologies, construction methods and techniques, and cost reduction techniques in support of the Supervisory Control and Data Acquisition (SCADA) monitoring systems used on the Distribution Networks. The monitoring system consists of a complex and extensive set of components used to assess the health and condition of the network transformers on a continuous basis. This research is looking at potential failure points on the monitoring system components and what technologies and improvements can be applied to increase life expectancy of these components and reduce production and maintenance costs for this system and similar systems.

iv. Scope
- Assess new technologies and feasibility of application on the Distribution Networks.
- Primary focus on technologies, components and work methods to extend the life expectancy of monitoring systems equipment and reduce long term maintenance costs.

v. Deliverables
- Modified or improved components identified for use on Distribution Network Monitoring System.
- Improved installation and construction work methods.
- Economic model for maintenance variables based on life expectancy testing of components.
- Changes to components.

vi. Metrics
- 1c - Avoided procurement and generation costs.
- 3a - Maintain/Reduce operations and maintenance costs.

vii. Schedule
- 3.25 years

viii. EPIC Funds Encumbered
- $453,000

ix. EPIC Funds Spent
- $76,012

x. Partners (if applicable)
- N/A

xi. Match Funding (if applicable)
- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A - No current evidence of IP development

xv. Status Updates

- Project is in Build/Test Phase.
- Completed competitive bidding for the identified research areas and awarded contract.
- Kicked off project with consultant and PG&E team members.
- Defined scope and started accelerated component testing (non-destructive).
- Next steps are to complete testing, and based on the results, design parameters for the next set of testing for component life cycle, to drive cost-based recommendations for system improvements.

Project #1.09C – Discrete Reactors

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Transmission

iii. Objective
- Gain operating experience with Discrete Series Reactors to determine whether such devices would be cost effective and operate reliably and safely on PG&E's transmission system.

iv. Scope
- Install and test 90 DSR units on the Las Positas-Newark 230 kV line
- Install and test Server at PG&E's San Francisco General Office (SFGO) headquarters, complete with Smart Wire System Manager Software
- Communication links between the DSRs and server to support the DSR monitoring and control.

v. Deliverables
- Installation, testing and analysis of DSR and server communication links
- Job Estimate to engineer, procure, construct and test the DSRs
- White paper describing project including go/no go recommendation
- Final report describing overall project, including finding from the operations and testing of DSR units and a recommendation as to whether or not to install the DSRs elsewhere in the PG&E system

vi. Metrics
- 7d - Deployment and integration of cost-effective distributed resources and generation, including renewable resources (PU Code §8360)
- 5a - Outage number, frequency and duration reductions
- 5b - Electric system power flow congestion reduction
- 3a - Maintain/Reduce operations and maintenance costs

vii. Schedule
- 3.25 years

viii. EPIC Funds Encumbered
- $1,418,585

ix. EPIC Funds Spent
- $1,998,883

x. Partners (if applicable)
- N/A

xi. Match Funding (if applicable)
- N/A

xii. Match Funding Split (if applicable)
- N/A

xiii. Funding Mechanism (if applicable)

- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A - No current evidence of IP development

xv. Status Updates

- Project is in Build/Test Phase.
- Selected the Las Positas-Newark 230 kV line (including tensile strength tests, identification of acceptable structures and spans for install).
- Ordered, received, installed DSR units and Power Line Commander Server with a communications link for monitor and control of the DSRs.
- Next steps are to perform testing, data collection and complete analysis and recommendations.

Project #1.10A – Dissolved Gas Analysis

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Transmission; Distribution

iii. Objective
- Develop tools and algorithms that analyze data from monitoring equipment installed on substation equipment (distribution and transmission) that tests for dissolved gasses or other precursor data that would assist in understanding the condition of the equipment.

iv. Scope
- Project scope being further evaluated - TBD

v. Deliverables
- Project deliverables being further evaluated - TBD

vi. Metrics
- TBD

vii. Schedule
- Project schedule being further evaluated - TBD

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)
- TBD

xv. Status Updates
- Project is currently on-hold.

Project #1.10C – Underground Cable Analysis

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Distribution

iii. Objective
- Develop tools and algorithms that analyze load and operating characteristic data from underground cables in order to develop an understanding of potential failure points, cable maintenance needs, and cable life expectancy.

iv. Scope
- Project scope being further evaluated - TBD

v. Deliverables
- Project deliverables being further evaluated - TBD

vi. Metrics
- TBD

vii. Schedule
- Project schedule being further evaluated - TBD

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)
- TBD

xv. Status Updates
- Project is currently on-hold.

Project #1.11 – Demonstrate Self-Correcting Tools to Improve System Records and Operations

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Transmission; Distribution

iii. Objective
- Demonstrate tools that identify and "register" existing assets to improve the integration between utility planning and operations. As part of the demonstration, implement "self-correcting" technologies that identifies plan vs. actual discrepancies and updates system records automatically. High priority use cases include: (1) Mapping of transformers to primary phase, (2) Mapping of customers to transformers and (3) Precision mapping of PG&Es overhead and underground network.

iv. Scope
- Project scope being further evaluated – TBD

v. Deliverables
- Project deliverables being further evaluated – TBD

vi. Metrics
- TBD

vii. Schedule
- Project schedule being further evaluated – TBD

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)
- TBD

xv. Status Updates
- Project is currently on-hold.

Project #1.12 – Demonstrate New Technologies That Improve Wildlife Safety and Protect Assets From Weather-Related Degradation

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Transmission; Distribution

iii. Objective
- Demonstrate new strategies and technologies to improve animal and bird protection, reduce outages caused by animals and birds, and protect assets from expensive weather-related degradation such as fog related corrosion.

iv. Scope
- Project scope being further evaluated - TBD

v. Deliverables
- Project deliverables being further evaluated - TBD

vi. Metrics
- TBD

vii. Schedule
- Project schedule being further evaluated - TBD

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)
- TBD

xv. Status Updates
- Project is currently on-hold.

Project #1.13 – Demonstrate New Communication Systems to Improve Substation Automation and Interoperability

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Transmission; Distribution

iii. Objective
- Demonstrate new strategies and technologies to convert and integrate multiple existing proprietary technologies within the substation environment for more effective operations. Substation are key operational hubs and represent significant investments, which must be further leveraged by engaging with vendors to create the next generation of interoperable substation services and products.

iv. Scope
- Project scope being further evaluated – TBD

v. Deliverables
- Project deliverables being further evaluated – TBD

vi. Metrics
- TBD

vii. Schedule
- Project schedule being further evaluated – TBD

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)
- TBD

xv. Status Updates
- Project is currently on-hold.

Project #1.14 – Next Generation SmartMeter™ Telecom Network Functionalities

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Distribution; Grid Operation/Market Design; Demand-Side Management

iii. Objective
- This project explores and discovers effective new network applications and devices to leverage and improve the SmartMeter™ communications network.

iv. Scope
- Leverage the existing SmartMeter™ network to support additional applications. Inform future uses of the SmartMeter™ network as to message capability, security, latency, and engineering constraints. Specifically focus on:
  - Test new devices to support network functions and capabilities not previously envisioned (e.g., new data streams, faster data collection).
  - Evaluate alternatives to decrease future upgrade, maintenance and/or operational costs.
  - Demonstrate different network applications, each focused on separate use cases.

v. Deliverables
- Evaluate new applications and devices, their associated data traffic impact on the SmartMeter™ network, and recommend which items warrant consideration for full-scale deployment.
- Develop business case based on findings for full deployment consideration

vi. Metrics
- 7f - Deployment of cost-effective smart technologies, including real time, automated, interactive technologies that optimize the physical operation of appliance and consumer devices for metering, communications concerning grid operations and status, and distribution automation (PU Code §8360).
- 7k - Develop standards for communication and interoperability of appliances and equipment connected to the electric grid, including the infrastructure serving the grid (PU Code §8360).
- Note: Each technology demonstrated may have additional specific benefits to name. For instance, the following could apply: improved communication for power restoration, improved control of streetlights, etc.

vii. Schedule
- 3 years

viii. EPIC Funds Encumbered
- $3,110,836

ix. EPIC Funds Spent
- $2,879,027

x. Partners (if applicable)
- N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)

- TBD - Smart Pole Meter and Meter Socket

xv. Status Updates

- Project is in Build/Test Phase.
- Completed 13 use cases, including Adaptive control streetlights, Mixed data use, Outage message analyses, etc.
- Remaining initiatives include improving Storm Center and restoration response, demonstrating communication with Distribution Automation (DA) devices, and demonstrating Smart Pole streetlight use case to remotely read the energy usage from telecommunications equipment and bill the equipment owner.

Project #1.15 – Grid Operations Situational Intelligence

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Distribution; Grid Operation/Market Design; Demand-Side Management

iii. Objective
- The objective of this pilot is to develop and pilot a real-time data visualization software platform for use by Electric Distribution Operations end users. Data will be integrated from various data sources and displayed on Distribution Control Center video walls and individual desktop computers, with potential for future scalability to handheld devices.
- This visualization tool may provide situational intelligence for a variety of end users outside of the Distribution Control Center, including the Emergency Operations Center, Grid Control Center, and potentially crews in the field, as well.
- This project contributes to objectives in the following CPUC proceeding(s): DRP R.14-08-013 / A. 15-07-006.

iv. Scope
- Scope includes the integration of data (network model, loading, SmartMeters™, outages, fire, weather, etc.) and a real-time data visualization platform for Distribution Operations.
- The Distribution Management System (DMS) platform and predictive analytics are not included in the scope.

v. Deliverables
- Demonstrate Real-time Data Visualization Platform, including data integration from a variety of data sources and a visual interface that includes geospatial, list, and trending layers.

vi. Metrics
- 5a - Outage number, frequency and duration reductions.
- 7b - Increased use of cost-effective digital information and control technology to improve reliability, security and efficiency of the electric grid (PU Code 8360).
- 3a - Maintain/Reduce operations and maintenance costs.

vii. Schedule
- 2.75 years

viii. EPIC Funds Encumbered
- $1,496,446

ix. EPIC Funds Spent
- $3,624,458

x. Partners (if applicable)
- N/A

xi. Match Funding (if applicable)
- N/A

xii. Match Funding Split (if applicable)
- N/A

xiii. Funding Mechanism (if applicable)

- Pay For Performance

xiv. Treatment of Intellectual Property (if applicable)

- New intellectual property has been created through co-development with the vendor. PG&E retains ownership rights to the IP and will provide free unlimited use rights to CA IOUs per the CPUC decision.

xv. Status Updates

- Project is in Build/Test Phase.
- Completed Beta go-live in one Control Center and the Emergency Operations Center.
- Successfully built in-house Distributed Generation Dashboard.
- Next steps are to pilot in front of Operators, and collect data of lessons learned for close-out report.

Project #1.16 – Vehicle-to-Grid Operational Integration

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Distribution

iii. Objective
- Leverage plug-in hybrid vehicle technology emerging in PG&E fleet to generate utility-grade power, supporting distribution circuits during planned or unplanned outage events.

iv. Scope
- Develop nominally 120kW exportable power capabilities from a plug-in hybrid electric truck. Seek to create the protocols necessary to safely connect the truck to the appropriate grid connection points. The portfolio of fleet vehicles (higher and lower weight classes) may broaden the range of available power ratings demonstrated by the project.

v. Deliverables
- Develop operating requirements for the vehicle.
- Understand engineering challenges with high power export with collaborative supplier development to solve.
- Develop safety and interconnection protocols to connect the vehicle to the grid leveraging existing protocols for temporary local generator set connection.
- Define and document power requirements for different outage/usage scenarios.
- Develop operating protocols (when and how the vehicles will be used).
- Develop unplanned outage protocols.
- Develop the hardware and software (if required) to connect the vehicle to PG&E's system.
- Build vehicles for field testing.

vi. Metrics
- 5a - Outage number, frequency and duration reductions
- 5e - Utility worker safety improvement and hazard exposure reduction
- 3a - Maintain/Reduce operations and maintenance costs.
- 4a - GHG emissions reductions (MMTCO2e)

vii. Schedule
- 3 years

viii. EPIC Funds Encumbered
- $1,479,590

ix. EPIC Funds Spent
- $3,582,003

x. Partners (if applicable)
- DOE/NREL; Edison Electric Institute engaged for elec. utility industry staging events; Portland General Electric closely collaborating for industry-level requirements

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A - No current evidence of IP development

xv. Status Updates

- Project is in Build/Test Phase.
- Leveraged National Renewable Energy Lab test facilities and funding for development tests.
- Used VOGSS vehicles for temporary power in real relief efforts during Northern California wild fires.
- Beta stage power export vehicles sourced and nearing build completion.
- Next steps are to complete electric operations field service testing and grid connection process development, with data collection and closeout.

Project #1.17 – Industry Participation to Leverage EPIC Dollars

i. Investment Plan Period
   - 1st Triennial (2012-2014)

ii. Assignment to Value Chain
   - Transmission; Distribution

iii. Objective
   - N/A

iv. Scope
   - Project scope being further evaluated – TBD

v. Deliverables
   - Project deliverables being further evaluated – TBD

vi. Metrics
   - TBD

vii. Schedule
   - Project schedule being further evaluated – TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - N/A

xii. Match Funding Split (if applicable)
   - N/A

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)
   - TBD

xv. Status Updates
   - Project is currently on-hold.

Project #1.18 – Appliance-Level Load Disaggregation

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Demand-Side Management

iii. Objective
- This project focuses on delivering the cost by major appliances to customers.

iv. Scope
- This project will use the data enabled by the SmartMeter™ platform to provide appliance-level itemization of monthly bill charges to customers, without their completing any audit or subscribing to any new service. This project assumes that minute level meter data is available.

v. Deliverables
- Quantify disaggregation accuracy and compare vendors.
- Based on results, provide recommendations for deployment strategy of appliance-level billing.

vi. Metrics
- 1f - Avoided customer energy use
- 1h - Customer bill savings (dollars saved)

vii. Schedule
- 2.5 years

viii. EPIC Funds Encumbered
- $1,043,508

ix. EPIC Funds Spent
- $1,190,639

x. Partners (if applicable)
- N/A

xi. Match Funding (if applicable)
- N/A

xii. Match Funding Split (if applicable)
- N/A

xiii. Funding Mechanism (if applicable)
- Pay for performance

xiv. Treatment of Intellectual Property (if applicable)
- N/A - No current evidence of IP development

xv. Status Updates
- Project is in Close-out Phase.
- Executed load disaggregation demonstration for ~500 customers. Evaluated the quality of three vendors' disaggregation algorithm results. Completed customer surveys and focus groups to evaluate perception and satisfaction of information.
- Next steps are to complete final report.

Project #1.19 – Enhanced Data Techniques and Capabilities via the SmartMeter™ Platform

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Distribution; Grid Operation/Market Design; Demand-Side Management

iii. Objective
- The project is to explore and discover effective, new data that can be collected and studied for further benefits. Demonstrate the type of additional data that can be collected and/or processed through the SmartMeterTM platform. Evaluate impact of any increased data traffic on the SmartMeterTM network. Focus on new data collection that makes the SmartMeter platform more robust for more customers.

iv. Scope
- Demonstrate the collection of new data from SmartMeters™. Example use cases include:
  - Power Quality Data (C12.19 format)
  - Mobile data collection methods
  - Power theft detection methodology using SmartMeter data for revenue assurance purposes

v. Deliverables
- Evaluate new data and analytic methodologies, their associated impact on the SmartMeter™.
- Recommendation of which data warrants consideration for full-scale deployment.
- Evaluation should provide key inputs to a business case for general deployment.

vi. Metrics
- 7f - Deployment of cost-effective smart technologies, including real time, automated, interactive technologies that optimize the physical operation of appliance and consumer devices for metering, communications concerning grid operations and status, and distribution automation
- 1h - Customer bill savings (dollars saved)
- 1f - Avoided customer energy use (KWh saved)
- 7b - Increased use of cost-effective digital information and control technology to improve reliability, security and efficiency of the electric grid.

vii. Schedule
- 3.25 years

viii. EPIC Funds Encumbered
- $1,010,207

ix. EPIC Funds Spent
- $1,510,127

x. Partners (if applicable)
- N/A

xi. Match Funding (if applicable)

- N/A

xii. Match Funding Split (if applicable)

- N/A

xiii. Funding Mechanism (if applicable)

- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Updates

- Project is in Staging Phase.
- Completed two use cases.
- Proved ability to collect power quality data, read meters in remote locations, add new data channels to SmartMetersTM, and detect Line Side Tap energy diversion cases with voltage and usage data.
- Next steps are to complete all use cases and complete final report.

Project #1.20 – Demonstrate the Benefits of Providing the Competitive, Open Market with Automated Access to Customer-Authorized SmartMeter™ Data to Drive Innovation

Formally notified CPUC on 10-31-13, project may be terminated as refined scope does not appear to meet safety, reliability and affordability guiding principles for priority R&D.

Project #1.21 – Automatic Identification of Distributed Photovoltaic (PV) Resources

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Distribution; Demand-Side Management

iii. Objective
- This project aims to validate and integrate a software platform to identify photovoltaic (PV) resources by leveraging SmartMeter™ data. This project focuses on addressing the issue of unauthorized interconnections in an automated fashion by developing and algorithm to identify resources, including integration with PG&E billing and interconnection database, as well as develop an automated outreach system for identified customers.
- This project contributes to objectives in the following CPUC proceeding(s): Interconnection R. 11-09-011 Rule 21.

iv. Scope
- Identify vendor to develop or pilot software
- Develop integration and communication platform for auto-identification of Unauthorized Interconnections (UIs)
- Demonstrate ability to automatically integrate software with billing and interconnection

v. Deliverables
- Successful integration of software with PG&E's Customer Care and Billing (CC&B) system.
- Successful tracking of all UIs identified.
- Successful tracking of communication and "conversion" of UIs to interconnection.

vi. Metrics
- 5d - Public safety improvement and hazard exposure reduction
- 5f - Reduced flicker and other power quality differences
- 5c - Forecast accuracy improvement

vii. Schedule
- 2.5 years

viii. EPIC Funds Encumbered
- $492,485

ix. EPIC Funds Spent
- $676,140

x. Partners (if applicable)
- N/A

xi. Match Funding (if applicable)
- N/A

xii. Match Funding Split (if applicable)
- N/A

xiii. Funding Mechanism (if applicable)

- Pay for performance

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Updates

- Project is in Design/Engineering Phase.
- Completed customer surveys to potential UIs that were used as feedback to verify functionality of the algorithm.
- Improved accuracy of PV identification (ID) and unauthorized interconnections algorithm, and developed method to estimate PV system size.
- Next steps are to finalize probabilistic algorithm that has the potential to enable ID of other DERs and complete final report.

Project #1.22 – Electric Vehicle Submetering

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Distribution; Grid Operations/Market Design; Demand-Side Management

iii. Objective
- EV submetering pilot to test subtractive metering process and Electric Vehicle Service Provider (EVSP) business models.
- This project contributes to objectives in the following CPUC proceeding(s): EV D.13-11-008.

iv. Scope
- EV submetering pilot will entail EVSPs delivering submeter data to IOU for subtraction from customer's primary meter to create an EV and a house bill. Customer will be responsible for both bills. In Phase 2, EVSP will be responsible for the bill.

v. Deliverables
- Process to receive EVSP submetered data.
- Process to subtract EV data from primary meter to create two bills.
- Inclusion of EV portion of bill on customer's monthly bill.
- Obtain 3rd party evaluator for both phases of pilot through a Request for Proposal (RFP).
- Incentive payments to EV Meter Data Management Agents (MDMA).

vi. Metrics
- 4a - GHG emissions reductions (MMTCO2e)
- 1h - Customer bill savings (MWh saved)

vii. Schedule
- 4.75 years (Extended by 6 mo. per CPUC request)

viii. EPIC Funds Encumbered
- $1,873,328

ix. EPIC Funds Spent
- $924,868

x. Partners (if applicable)
- Partnering with the following three Meter Data Management Agents (MDMAs) to assess electric vehicle service provider models: OhmConnect; eMotorWerks, and NRG.

xi. Match Funding (if applicable)
- N/A

xii. Match Funding Split (if applicable)
- N/A

xiii. Funding Mechanism (if applicable)
- N/A

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Updates

- Project in Build/Test phase.
- Closed enrollment on 8/31/15 with 132 pilot participants and three Meter Data Management Agents (MDMAs).
- Executed competitive RFP and selected vendor to act as third party evaluator.
- Next steps include working with IOUs, CPUC and MDMAs to scope, define and launch Phase 2 of the project, as well as obtain evaluation results from Nexant.

Project #1.23 – Photovoltaic (PV) Submetering

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Distribution; Grid Operations and Market Design; Demand-Side Management

iii. Objective
- Initiative to obtain additional unnetted PV data to support customer call center bill experience, and provide additional service to its customers. PV generation data will be integrated with existing MyEnergy web portal for customers' benefit.
- This project contributes to objectives in the following CPUC proceeding(s): DG R.12-11-005.

iv. Scope
- Explore four different methods for obtaining PV generation data (Dedicated smart meter, submeter communication via ZigBee radio, 3rd party estimates, and data exchange with solar companies, and work with vendor to relay data to customer.

v. Deliverables
- Implement pilot program for dedicated smart meters and third party estimates.
- Explore opportunities for submetering technology and solar company data exchange.
- Modify existing Customer Data Warehouse (CDW)/MyEnergy interface to allow for additional data streams and visualization.
- Evaluate relative merits of various generation measurement/estimation approaches.

vi. Metrics
- 5c - Forecast accuracy improvements
- 7b - Increased use of cost-effective digital information and control technology to improve reliability, security and efficiency of the electric grid (PU Code 8360)

vii. Schedule
- 2.5 years

viii. EPIC Funds Encumbered
- $928,438

ix. EPIC Funds Spent
- $796,288

x. Partners (if applicable)
- N/A

xi. Match Funding (if applicable)
- N/A

xii. Match Funding Split (if applicable)
- N/A

xiii. Funding Mechanism (if applicable)
- Pay for performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A - No current evidence of IP development

xv. Status Updates

- Project is in Build/Test Phase.
- Completed lab testing and developed process to receive and display solar generation estimates for 10,000 PV systems from third-party solar tool.
- Deployed sub-meters to measure accuracy of estimated solar generation algorithm.
- Tested and launched My Energy website with PV generation data for 10,000 customers in 2015.
- Next steps are to analyze estimated accuracy compared to sub-meters, as well as collect and summarize customer feedback.

Project #1.24 – Demand-Side Management (DSM) for Transmission and Distribution (T&D) Cost Reduction

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Transmission; Distribution; Grid Operation/Market Design; Demand-Side Management

iii. Objective
- Assess how to best utilize DSM resources to create a targeted customer- and location-specific approach to assist with distribution capacity constraints.
- This project contributes to objectives in the following CPUC proceeding(s): DRP R.14-08-013 / A. 15-07-006.

iv. Scope
- Improve ability to estimate Heating, Ventilation and Air Conditioning (HVAC) direct load control load impacts at the distribution feeder level to aid in better understanding of the localized impact of HVAC direct load control devices on meeting distribution feeder level reliability concerns.

v. Deliverables
- Deploy data logging devices on a scientific sample of existing SmartAC Cycling customers, to enable real time monitoring of device performance and load impacts at feeder-level.
- Develop infrastructure to make real-time data available on feeder-level load impacts of SmartAC Cycling to distribution operations.
- Produce report describing a case study methodology of targeting and valuing customer side peak load reductions at the feeder level.

vi. Metrics
- 4A - GHG emissions reductions (MMTCO2e)
- 1h - Customer bill savings (MWh saved)
- 7b - Increased use of cost-effective digital information and control technology to improve reliability, security and efficiency of the electric grid (PU Code 8360)

vii. Schedule
- 2 years

viii. EPIC Funds Encumbered
- $1,196,477

ix. EPIC Funds Spent
- $1,321,096

x. Partners (if applicable)
- N/A

xi. Match Funding (if applicable)
- N/A

xii. Match Funding Split (if applicable)
- N/A

xiii. Funding Mechanism (if applicable)

- Pay for performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A - No current evidence of IP development

xv. Status Updates

- Project is in Close-out Phase.
- Project team has deployed and tested all 600 real time data loggers.
- Finalized build and testing of Real-Time Monitoring System (RTMS) dashboard.
- Developed and implemented RTMS test plan, including collection and analysis of event data.

Project #1.25 – Direct Current (DC) Fast Charging Mapping

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Distribution; Demand-Side Management

iii. Objective
- Develop, pilot, and validate approaches that help determine the optimal location of direct current (DC) fast chargers based on traffic patterns and distribution grid infrastructure.

iv. Scope
- Acquire travel pattern data and grid infrastructure capability data to identify low-cost, high utilization areas in which to integrate DC fast chargers into PG&E's distribution system.

v. Deliverables
- Develop a process to identify optimal DC fast charging sites.
- Develop a map that presents the locations of optimal DC fast charging sites in a meaningful manner to customers.

vi. Metrics
- 3a - Maintain/Reduce capital costs
- 3d - Number of operations of various existing equipment types before and after adoption of a new smart grid component, as an indicator of possible equipment life extensions from reduced wear and tear
- 7l - Identification and lowering of unreasonable or unnecessary barriers to adoption of smart grid technologies, practices, and services.

vii. Schedule
- 2.5 years

viii. EPIC Funds Encumbered
- $285,225

ix. EPIC Funds Spent
- $336,595

x. Partners (if applicable)
- N/A

xi. Match Funding (if applicable)
- N/A

xii. Match Funding Split (if applicable)
- N/A

xiii. Funding Mechanism (if applicable)
- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)
- TBD

xv. Status Updates
- Project is in the Design/Engineering phase.

- Project kicked-off and partners identified.
- Completed competitive bid process and selected vendor to develop method for site selection.
- Finalized literature review and interviews, as well as the algorithm methodology for rank ordering site locations for placement of the DC fast chargers.
- Next steps are to finalize identification of ~200-500 DCFC locations across PG&E's territory.

Project #1.26 – Pilot Measurement and Telemetry Strategies and Technologies That Enable the Cost-Effective Integration of Mass Market Demand Response (DR) Resources Into the California Independent System Operator Corporation Wholesale Market

i. Investment Plan Period
- 1st Triennial (2012-2014)

ii. Assignment to Value Chain
- Grid Operations and Market Design; and Demand-side Management.

iii. Objective
- Develop, pilot and validate approaches and technologies that enable the cost-effective integration (specifically, the measurement and telemetry) of mass market DR resources into the CAISO wholesale market. While other DR projects focus on integration of DR resources into various utility and future ISO operational needs, this project intends to test alternative telemetry solutions and technologies to satisfy CAISO operational visibility requirements

iv. Scope
- Project scope being further evaluated – TBD

v. Deliverables
- Project deliverables being further evaluated – TBD

vi. Metrics
- TBD

vii. Schedule
- Project schedule being further evaluated – TBD

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)
- TBD

xv. Status Updates
- Project is currently on-hold.

Project #2.01 Evaluate Storage on the Distribution Grid

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Grid Operations/Market Design; Transmission; Distribution; Demand-side Management

iii. Objective
   - Identify and evaluate whether system needs can be cost-effectively addressed with energy storage, including identifying a range of storage deployment locations and grid interconnection requirements on a granular level.

iv. Scope
   - Project scope being further evaluated – TBD

v. Deliverables
   - Project deliverables being further evaluated – TBD

vi. Metrics
   - TBD

vii. Schedule
   - Project schedule being further evaluated – TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)
   - TBD

xv. Status Updates
   - Project is currently on-hold.

Project #2.02 Pilot Distributed Energy Management Systems (DERMS)

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- Grid Operations and Market Design

iii. Objective
- Demonstrate new technology to monitor and control DERs to manage system constraints and evaluate the potential value of DER flexibility to the grid. The DERMS pilot will drive learning about the people, process, and technology needed to operate the high DER penetration grid of 2025.
- Create, test, and iterate on future DERMS requirements (e.g., communication requirements for PG&E and 3rd party owned DERs)
- Learn about business process change and personnel skills & knowledge needed to implement DERMS
- Enable informed choice for long-term strategic vendor in 2017 and beyond (pilot is not choosing the long term vendor)
- This project contributes to objectives in the following CPUC proceeding(s): DRP R.14-08-013 / A. 15-07-006.

iv. Scope
- Demonstrate minimum viable DERMS operation at PG&E to address key DER management use cases.
- The demonstration will take place in a limited geography with a diverse set of DERs being monitored and controlled by the pilot DERMS.

v. Deliverables
- The functional integration of a DERMS software minimum viable product and operational demonstration of the identified use cases.
- A report that:
  - Determines the most important characteristics of a full deployment solution including detailed functional and technical requirements
  - Identifies best practices and required internal capabilities for a full deployment solution
  - Develops operational processes that can be scaled to a wider system deployment
  - Defines boundaries and integrations with other PG&E systems (e.g., DRMS, DMS, market systems)
  - Develops a point of view on the utility role in managing DERs for grid and economic benefits

vi. Metrics
- 7b. Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (PU Code § 8360)
- 7d. Deployment and integration of cost-effective distributed resources and generation, including renewable resources (PU Code § 8360)

vii. Schedule
- 2 years

viii. EPIC Funds Encumbered
- $477,287

ix. EPIC Funds Spent
- $475,503

x. Partners (if applicable)
- N/A

xi. Match Funding (if applicable)
- N/A

xii. Match Funding Split (if applicable)
- N/A

xiv. Treatment of Intellectual Property (if applicable)
- Pay for performance TBD

xv. Status Updates
- Project is in Plan/Analyze Phase.
- Benchmarked DERMS strategy and pilots with other leading U.S. utilities.
- Completed competitive bid process and selected vendor.
- Next steps are to sign contract with vendor and execute use cases.

Project #2.03A Test Smart Inverter Enhanced Capabilities - Photovoltaics (PV)

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- Distribution; Demand-Side Management

iii. Objective
- This project will explore the use and impact of aggregated customer-sited smart inverters to help inform emerging industry standards, as well as define the operational and communication requirements to support the advancement and deployment of new inverter technologies.
- This project contributes to objectives in the following CPUC proceeding (s): DRP R.14-08-013 / A. 15-07-006.

iv. Scope
- This project will leverage the results of the lab testing of smart inverter functionalities that is being completed by PG&E's Smart Grid Pilot Volt/Var Optimization (VVO) Project at PG&E's Applied Technologies Lab (as specified by the Smart Inverter Working Group).
- This EPIC project will deploy smart inverters on one or more feeders to evaluate their effectiveness in improving PV integration and mitigation safety risks.

v. Deliverables
- Identify feeder(s) where smart inverters will be installed for demonstration.
- Demonstrate the use of smart inverters on one or more feeders to demonstrate the inverters' local voltage control capabilities and impacts related to high penetration of customer-sited solar PV.
- Develop any necessary communications software/hardware/technologies between the utility and 3rd party aggregator or end devices.
- Evaluate the performance of smart inverters.

vi. Metrics
- 3a. Maintain / Reduce operations and maintenance costs.
- 7d. Deployment and integration of cost-effective distributed resources and generation, including renewable resources

vii. Schedule
- 2.5 years

viii. EPIC Funds Encumbered
- $146,000

ix. EPIC Funds Spent
- $27,275

x. Partners (if applicable)
- PG&E Smart Grid VVO Pilot

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)

- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Updates

- Project is in Plan/Analyze Phase.
- Identified short list of substations and feeders to propose for site location.
- Next steps are to finalize smart inverter testing, select transformer bank/feeders for deployment, select vendor, and commence field deployment of smart inverters.

Project #2.03B Test Smart Inverter Enhanced Capabilities - Electric Vehicle (EV)

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- Distribution; Demand-Side Management

iii. Objective
- As a complement to the smart inverter assessment related to Photovoltaics (PV) in project 2.03A. Smart Inverters for PV, this project will assess the use and impact of EV energy flow capabilities, as required by D.15-04-020.
- This project contributes to objectives in the following CPUC proceeding (s): DRP R.14-08-013 / A. 15-07-006.

iv. Scope
- This EPIC project will enable dispatchable charging and discharging of the EV in response to an Open Automated Demand Response (OADR) event signals. Varied test modes will be tested.

v. Deliverables
- Evaluation of the performance of the EV in response to OADR signals and impacts on energy flow capabilities

vi. Metrics
- 3a. Maintain / Reduce operations and maintenance costs.
- 7d. Deployment and integration of cost-effective distributed resources and generation, including renewable resources

vii. Schedule
- 1.5 years

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)
- TBD

xv. Status Updates
- Project is in Plan/Analyze Phase.
- Identified potential site location and partner to execute project.
- Next steps are to finalize partner, execute SOW, and commence testing.

Project #2.04 DG Monitoring & Voltage Tracking

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- Grid Operation/Market Design

iii. Objective
- This project aims to utilize the voltage measurement capabilities of SmartMeters™ to monitor DG output and identify voltage fluctuations caused by the intermittent nature of distributed renewable resources. Project will use data analytics techniques and Advanced Metering Infrastructure (AMI) (and other) data to determine the impact of PV penetration on Rule-2-violations and create a rating for the probability that a Rule 2 violation is caused by DG.
- This project contributes to objectives in the following CPUC proceeding(s): DRP R.14-08-013 / A. 15-07-006.

iv. Scope
- Create an algorithmic process output rating on the likelihood of a voltage violation (on a given transformer) being caused by DG fluctuations.

v. Deliverables
- Develop an analytics process / algorithm to analyze AMI and other data for high penetration DG feeders, as well as some low penetration feeders for baselining.
- Evaluate impact of DG penetration on voltage.

vi. Metrics
- 3a. Maintain / Reduce operations and maintenance costs
- 7b - Increased use of cost-effective digital information and control technology to improve reliability, security and efficiency of the electric grid (PU Code 8360)
- 7d. Deployment and integration of cost-effective distributed resources and generation, including renewable resources

vii. Schedule
- 1.75 Years

viii. EPIC Funds Encumbered
- $158,500

ix. EPIC Funds Spent
- $95,026

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Updates

- Project is in Plan/Analyze Phase.
- Established success criteria for Phase 2-5.
- Next steps are to plan for and execute vendor selection process and develop algorithm.

Project #2.05 Inertia response emulation for DG impact improvement

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- Grid Operations/ Market Design; Transmission

iii. Objective
- Demonstrate the capability to emulate inertia injection and support primary frequency control using energy storage and smart inverter technologies to potentially mitigate the impacts of large-scale DG to the grid, improve the grid performance and reliability, and advance California energy policy to increase the amounts of renewable and distributed generation on the grid.

iv. Scope
- Project scope being further evaluated – TBD

v. Deliverables
- Project deliverables being further evaluated – TBD

vi. Metrics
- TBD

vii. Schedule
- Project schedule being further evaluated – TBD

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)
- TBD

xv. Status Updates
- Project is currently on-hold.

Project #2.06 Intelligent Universal Transformer (IUT)

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- Distribution; Grid Operation/Market Design; Demand-Side Management

iii. Objective
- The project objective is to develop and demonstrate a solid-state transformer field prototype Medium Voltage Fast Charger (MVFC) system, as an application use case of solid-state transformers for DC fast charging of plug-in electric vehicles (PEV), featuring intelligent controls and multiple fast charging of PEVs

iv. Scope
- Test demonstration and communication to the same DC solid-state transformer with two protocols.

v. Deliverables
- Demonstrate a proof of concept that 1) an IUT can be used in lieu of other equipment to connect to Direct Current Fast Charge (DCFC) protocols, and 2) an IUT can communicate back to the utility.

vi. Metrics
- 3a. Maintain / Reduce operations and maintenance costs
- 3b. Maintain/Reduce capital costs
- 5d. Public safety improvement and hazard exposure reduction
- 7k. Develop standards for communication and interoperability of appliances and equipment connected to the electric grid, including the infrastructure serving the grid
- 7l. Identification and lowering of unreasonable or unnecessary barriers to adoption of smart grid technologies, practices, and services.

vii. Schedule
- 2.25 years

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)
- TBD

xv. Status Updates

- Project is in Plan/Analyze Phase.
- Next steps are to identify partners/vendors, select site, develop testing protocols, finalize component build, complete field testing and monitoring, and analyze results.

Project #2.07 Real-time Loading Data for Distribution Operations and Planning

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- Grid Operation/Market Design; Distribution

iii. Objective
- This demonstration will leverage near real time and interval data to improve feeder modeling, inform load allocation throughout the distribution grid and transformer loading profiles, and identify opportunities to enhance current load forecasting processes for distribution transformers, feeders and substation transformers.

iv. Scope
- Current technology does not allow for real time line or transformer loading information without full Supervisory Control and Data Acquisition (SCADA) penetration.
- Project will aggregate the meter loading to the transformer level at a higher frequency level.

v. Deliverables
- Develop a unique loading algorithm and rubrics for determining cost-effective data sources and cadences.

vi. Metrics
- 7b. Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid

vii. Schedule
- 1.75 years

viii. EPIC Funds Encumbered
- $198,867

ix. EPIC Funds Spent
- $138,829

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)
- TBD

xv. Status Updates
- Project is in Plan/Analyze Phase.
- Next steps are to prepare vendor requirements, execute competitive bid process and develop algorithm.

Project #2.08 "Smart" Monitoring and Analysis Tools

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Transmission

iii. Objective
   - Demonstrate strategies and technologies for real time, online monitoring of substation equipment; Demonstrate communication protocols and equipment to support the smart devices; Develop visualization techniques for improved monitoring; and evaluate new vendor technologies that enable data correlation and predictive analysis to better identify and respond to potential safety, reliability and/or operational issues.

iv. Scope
   - Project scope being further evaluated – TBD

v. Deliverables
   - Project deliverables being further evaluated – TBD

vi. Metrics
   - TBD

vii. Schedule
   - Project schedule being further evaluated – TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)
   - TBD

xv. Status Updates
   - Project is currently on-hold.

Project #2.09 Distributed Series Impedance (DSI) (Phase 2)

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- Transmission

iii. Objective
- Demonstrate congestion mitigation by installing DSIs on parallel transmission facilities to demonstrate the next generation of the Distributed Series Reactor (DSR) devices from the First EPIC Triennial Plan, which may allow for better control of transmission line loading.

iv. Scope
- Project scope being further evaluated – TBD

v. Deliverables
- Project deliverables being further evaluated – TBD

vi. Metrics
- TBD

vii. Schedule
- Project schedule being further evaluated – TBD

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)
- TBD

xv. Status Updates
- Project is currently on-hold.

Project #2.10 Emergency Preparedness Modeling

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- Transmission; Distribution

iii. Objective
- Incorporate natural hazard damage model information into one integrated algorithm/tool, which would provide the ability to quickly estimate the impacts of natural hazards on PG&E facilities to enable faster response and restoration.
- Provide the ability to prepare for these hazards by proactively modeling the impacts of potential hazards, to understand system vulnerabilities and restoration resource requirements.
- Incorporate work efficiency optimization algorithms to more efficient allocate crews.

iv. Scope
- Develop optimization algorithms and visualization tool that includes asset locations and conditions with multiple potential hazards, which allows for the aggregation of equipment damage estimates (via damage models, outage information systems, and damage assessments), est. hours to repair, and recommended allocation of work resources to efficiently respond to a natural hazard

v. Deliverables
- Complete algorithms that aggregates data from multiple sources to feed into application.
- Incorporate multiple algorithms into a proof of concept visualization tool.
- Develop recommendation for deployment strategy.

vi. Metrics
- 3a. Maintain / Reduce operations and maintenance costs
- 4a. GHG emissions reductions (MMTCO2e)
- 5a. Outage number, frequency and duration reductions
- 5d. Public safety improvement and hazard exposure reduction
- 5e. Utility worker safety improvement and hazard exposure reduction
- 5c. Forecast accuracy improvement

vii. Schedule
- 2.25 years

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $25

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)
- TBD

xv. Status Updates
- Project is in Plan/Analyze Phase.
- Next steps are to complete competitive bid process, select vendor, gather data, and develop resource allocation algorithm/tool.

Project #2.11 New Mobile Technology & Visualization Applications

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Distribution

iii. Objective
   - Demonstrate tailored, advanced mobile applications for PG&E field operations that build upon Grid Operations Situational Intelligence (Project #15) demonstration projects in the EPIC First Triennial Plan as well as existing “baseline” mobile deployments underway.

iv. Scope
   - Project scope being further evaluated – TBD

v. Deliverables
   - Project deliverables being further evaluated – TBD

vi. Metrics
   - TBD

vii. Schedule
   - Project schedule being further evaluated – TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)
   - TBD

xv. Status Updates
   - Project is currently on-hold.

Project #2.12 New Emergency Management Mobile Applications

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Transmission; Distribution

iii. Objective
   - Develop new mobile applications to enhance PG&E's emergency preparedness and response capabilities.

iv. Scope
   - Project scope being further evaluated – TBD

v. Deliverables
   - Project deliverables being further evaluated – TBD

vi. Metrics
   - TBD

vii. Schedule
   - Project schedule being further evaluated – TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)
   - TBD

xv. Status Updates
   - Project is currently on-hold.

Project #2.13 Digital Substation/Substation Automation

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- Transmission; Distribution

iii. Objective
- Investigate and evaluate sustainable protection and control technologies for future "digital" substations, which may include testing technologies in a lab setting, and performing a pilot implementation to demonstrate technology adoption and integration with legacy substation protection and control technologies.

iv. Scope
- Project scope being further evaluated – TBD

v. Deliverables
- Project deliverables being further evaluated – TBD

vi. Metrics
- TBD

vii. Schedule
- Project schedule being further evaluated – TBD

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)
- TBD

xv. Status Updates
- Project is currently on-hold.

Project #2.14 Automatically Map Phasing Information

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- Distribution; Demand-Side Management

iii. Objective
- This project aims to explore a variety of pre-commercial analytics and/or hardware options to automatically map 3-phase electrical power information in order to improve the distribution network models. Use of Advanced Metering Infrastructure (AMI) data; Light Detection and Ranging mapping technology; Micro Phasor Measurement Units (PMUs); and hardware at the transformer may provide this automated capability.

iv. Scope
- Project seeks to improve distribution network models through automatic mapping of 3-phase electrical power information.

v. Deliverables
- Develop algorithm or novel process to use AMI data and other sources to determine the assignment of Phases to conducting components.
- Complete an analysis on the most cost-effective frequency for running such a mapping process.

vi. Metrics
- 7b. Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid

vii. Schedule
- 1.75 years

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)
- TBD

xv. Status Updates
- Project is in Plan/Analyze Phase.
- Next steps are to execute competitive bid process and develop algorithm/analytics options.

Project #2.15 Synchrophasor Applications for Generator Dynamic Model Validation

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- Transmission

iii. Objective
- This project will evaluate new Synchrophasor analysis applications that can perform generator dynamic model parameter estimation and validation using disturbance data recorded by the Synchrophasor system. New Synchrophasor applications could perform mandated generator model validation without requiring time- and labor-intensive on-site tests, and could detect sub-synchronous resonance and other conditions which can cause generator outages. The objective of this project is to determine if this analysis is accurate and cost-effective on PG&E's system.

iv. Scope
- Scope is limited to confirming that analysis of Phasor Measurement Unit (PMU) data is equal to costly on-site model validation in the target geography. Scope does not include widespread deployment of PMUs or validation process.

v. Deliverables
- Install Synchrophasors (or "PMUs") on generators or generator tie-lines, and test new data analysis software applications.
- Evaluate the applications' ability to perform generator dynamic model validation by analyzing Synchrophasor data following transient disturbances on the transmission system.

vi. Metrics
- 3a. Maintain / Reduce operations and maintenance costs
- 5a. Outage number, frequency and duration reductions
- 7b. Increased use of cost-effective digital information and control technology to improve reliability, security and efficiency of the electric grid (PU Code 8360)

vii. Schedule
- 2.5 year

viii. EPIC Funds Encumbered
- $148,050

ix. EPIC Funds Spent
- $90,355

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Updates

- Project is in Plan/Analyze Phase.
- Next steps are to identify appropriate test facilities/ geography, contract with additional vendors, install Synchrophasors, and test.

Project #2.16 Enhanced Synchrophasor Analytics & Applications

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- Transmission

iii. Objective
- Demonstrate new techniques to synthesize Synchrophasor data and utilize the data for advanced real-time system applications, such as wide-area monitoring, protection, and control systems, which could help move Synchrophasor applications beyond planning, forensics, and visualization to enhanced wide-area monitoring, protection, and control applications.

iv. Scope
- Project scope being further evaluated – TBD

v. Deliverables
- Project deliverables being further evaluated – TBD

vi. Metrics
- TBD

vii. Schedule
- Project schedule being further evaluated – TBD

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)l
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)
- TBD

xv. Status Updates
- Project is currently on-hold.

Project #2.17 Geomagnetic Disturbance (GMD) Evaluation

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- Transmission

iii. Objective
- Evaluate system vulnerability to Geomagnetic Disturbance (GMD) by modeling GMD that occurs during a geomagnetic storm and evaluating the impact on transmission lines, interconnection lines, substations and system voltages.

iv. Scope
- Project scope being further evaluated – TBD

v. Deliverables
- Project deliverables being further evaluated – TBD

vi. Metrics
- TBD

vii. Schedule
- Project schedule being further evaluated – TBD

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)
- TBD

xv. Status Updates
- Project is currently on-hold.

Project #2.18 Optical Instrument Transformers and Sensors for Protection and Control Systems

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- Transmission

iii. Objective
- Demonstrate newer technologies, such as optical sensors, as well as strategies and technologies to configure appropriate protection settings, including the coordination required between both new and conventional instrumentation.

iv. Scope
- Project scope being further evaluated – TBD

v. Deliverables
- Project deliverables being further evaluated – TBD

vi. Metrics
- TBD

vii. Schedule
- Project schedule being further evaluated – TBD

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)
- TBD

xv. Status Updates
- Project is currently on-hold.

Project #2.19 Enable Distributed Demand-side Strategies & Technologies

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- Distribution; Demand-Side Management

iii. Objective
- Demonstrate distributed demand-side technologies and approaches to address local and flexible resource needs.
- This project contributes to objectives in the following CPUC proceeding(s): Energy Storage OIR R.15-03-011.

iv. Scope
- Deploy an aggregation of BTM customer energy storage resource to reduce peak loading or absorb distributed generation on a utility distribution feeder(s).

v. Deliverables
- Demonstrate and test field results for effectiveness of the use of aggregated customer-sited BTM energy storage resources to peak load reduction reduce peak loading or absorb distributed generation on a utility distribution feeder(s).
- Potential to demonstrate communications with aggregate resources for visualization and control.
- Evaluate cost-effectiveness and reliability of BTM energy storage for addressing capacity constraints.

vi. Metrics
- 1c. Avoided procurement and generation costs
- 1i. Nameplate Capacity of Grid-Connected Storage
- 3f. Improvements in system operation efficiencies stemming from increased utility dispatchability of customer demand side management
- 5b. Electric system power flow congestion reduction
- 5d. Public safety improvement and hazard exposure reduction
- 7b. Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid
- 7d. Deployment and integration of cost-effective distributed resources and generation, including renewable resources

vii. Schedule
- 2.25 years

viii. EPIC Funds Encumbered
- $146,000

ix. EPIC Funds Spent
- $55,253

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)

- TBD

xiii. Funding Mechanism (if applicable)

- TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Updates

- Project is in Plan/Analyze Phase.
- Identified a short list of substations and feeders to propose for site location.
- Next steps are to select transformer bank/feeders for deployment, complete RFP to select vendor, develop contracts, acquire customer participants and commence field deployment of BTM batteries.

Project #2.20 Real-time Energy Usage Feedback to Customers

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Grid Operations/ Market Design; Distribution; Demand-side Management

iii. Objective
   - Evaluate innovative feedback technologies to provide near real-time energy usage information to customers and to drive greater customer performance during DR events.

iv. Scope
   - Project scope being further evaluated – TBD

v. Deliverables
   - Project deliverables being further evaluated – TBD

vi. Metrics
   - TBD

vii. Schedule
   - Project schedule being further evaluated – TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)
   - TBD

xv. Status Updates
   - Project is currently on-hold.

Project #2.21 Home Area Network (HAN) for Commercial Customers

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- Demand-Side Management

iii. Objective
- This project will demonstrate the application of HAN technology to PG&E's commercial customers.
- This project contributes to objectives in the following CPUC proceeding(s): A.11-03-001.

iv. Scope
- This project will enable the ZigBee HAN radio on Large Commercial and Industrial (LC&I) meters, to facilitate LC&I customer access to real time usage data, as well as testing of the integration with existing Energy Management Systems (EMS).

v. Deliverables
- Install ZigBee HAN devices with selected LC&I customers and connect devices to SmartMeters.
- Monitor customer usage and issue/collect customer and vendor surveys.
- Complete report with identified issues and recommendations for how to integrate with an existing EMS.

vi. Metrics
- 1e. Peak load reduction (MW) from summer and winter programs
- 1f. Avoided customer energy use (kWh saved)
- 1h. Customer bill savings (dollars saved)
- 3a. Maintain / Reduce operations and maintenance costs
- 4a. GHG emissions reductions (MMTCO2e)
- 7b. Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (PU Code § 8360)

vii. Schedule
- 1.5 years

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)

- TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Updates

- Project is in Plan/Analyze Phase.
- Developed business plan and identified vendor/partner.
- Next steps are to complete design, build and test phases, including customer site identification, lab testing, deployment of devices, field testing and integration with EMS.

Project #2.22 Demand Reduction Through Targeted Data Analytics

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- Distribution; Demand-Side Management

iii. Objective
- Identify strategic customers and target demand reduction in local areas by combining and integrating multiple Demand-Side Management (DSM) technologies (e.g., Energy Efficiency (EE), Demand Response (DR), Distributed Energy Storage, Consumer-oriented Energy Tools).
- Investigate whether PG&E can achieve a sufficient amount of demand reduction, give visibility into the customer-side resources and improve the reliability of customer-side resources at the local level, in order to reschedule local capacity expansion expenditures.
- This project contributes to objectives in the following CPUC proceeding(s): DRP R.14-08-013 / A. 15-07-006.

iv. Scope
- Develop a solution/tool that determines needed customer demand reduction individually and in aggregate at asset level, leveraging interval and Supervisory Control and Data Acquisition (SCADA) data.
- Develop cross-Distributed Energy Resource (DER) customer targeting to address forecasted capacity challenges at specific assets, for specific days and times of year, leveraging interval data and other customer attributes

v. Deliverables
- Create a data analytics platform capable of combining and analyzing multi-structured data, linking to a variety of data sources.
- Develop a method for identification, valuation, implementation, and tracking of targeted DERs.
- Create a quantitative screening/rank order tool.
- Develop actionable DER recommendations to customer outreach teams for reaching demand reduction goals

vi. Metrics
- 3a. Maintain / Reduce capital costs
- 7b. Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid
- 7e. Development and incorporation of cost-effective demand response, demand-side resource, and energy efficient resources
- 7h. Deployment and integration of cost-effective advanced electricity storage and peak-shaving technologies, including plug-in electric and hybrid electric vehicles, and thermal-storage air-conditioning

vii. Schedule
- 2.25 years

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)
- TBD

xv. Status Updates
- Project is in Plan/Analyze Phase.
- Identified data integration and analytics platform vendor and narrowed grid assets to be analyzed in the project.
- Next steps are to complete data gathering, integrate or staging of datasets, develop analytics platform, create quantitative screening tool, and build interface with targeted DER sales guidance.

Project #2.23 Integrate Demand-side Approaches Into Utility Planning

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- Distribution; Demand-Side Management

iii. Objective
- This project will enhance PG&E's ability to incorporate the growing usage of DERs into distribution planning tools by developing new customer class load shapes that incorporate DERs and a methodology for modeling DER deployment uncertainty at the circuit level.
- This project contributes to objectives in the following CPUC proceeding(s): DRP R.14-08-013 / A. 15-07-006.

iv. Scope
- Integrate a broader range of customer-side technologies and DER approaches into grid planning and operations in a least cost framework by enhancing distribution load forecasting tools to include new customer load shapes based on the usage of DERs and to model the uncertainty of DER deployment at the circuit level.

v. Deliverables
- Develop enhanced Customer and DER Load Shapes Catalog in LoadSEER Planning Tool.
- Incorporate DER Scenario Projections into LoadSEER.
- Develop interface between LoadSEER/CYME for batch processing integration.

vi. Metrics
- 1c. Avoided procurement and generation costs
- 3f. Improvements in system operation efficiencies stemming from increased utility dispatchability of customer demand side management
- 5c. Forecast accuracy improvement
- 7e. Development and incorporation of cost-effective demand response, demand-side resources, and energy-efficient resources (PU Code § 8360)

vii. Schedule
- 2 years

viii. EPIC Funds Encumbered
- $1,250,085

ix. EPIC Funds Spent
- $551,221

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)

- Pay for Performance

xiv. Treatment of Intellectual Property (if applicable)

- N/A

xv. Status Updates

- Project is in Build/Test Phase.
- Developed Statement of Work (SOW) and selected vendor, completed initial data transfer to vendor, and incorporated enhanced customer and DER load shapes catalog into LoadSEER planning tool.
- Next steps are to incorporate DER scenario projections into LoadSEER, complete user acceptance testing, develop interface between LoadSEER and CYME, and develop the integrated capacity analysis modules within LoadSEER.

Project #2.24 Appliance Level Bill Disaggregation for Non-residential Customers

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- Demand-Side Management

iii. Objective
- Demonstrate the ability to use sub-minute level usage information to determine appliance load for non-residential customers.

iv. Scope
- Project scope being further evaluated – TBD

v. Deliverables
- Project deliverables being further evaluated – TBD

vi. Metrics
- TBD

vii. Schedule
- Project schedule being further evaluated – TBD

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $0

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)
- TBD

xv. Status Updates
- Project is currently on-hold.

Project #2.25 Enhanced Smart Grid Communications

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Grid Operations/ Market Design; Distribution; Demand-side Management

iii. Objective
   - Evaluate license spectrum providers that have developed technologies offered on the Federal Communications Commission (FCC) license frequency range/spectrum.

iv. Scope
   - Project scope being further evaluated – TBD

v. Deliverables
   - Project deliverables being further evaluated – TBD

vi. Metrics
   - TBD

vii. Schedule
   - Project schedule being further evaluated – TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)
   - TBD

xv. Status Updates
   - Project is currently on-hold.

Project #2.26 Customer & Distribution Automation Open Architecture Devices

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- Distribution; Grid Operation/Market Design; Demand-Side Management

iii. Objective
- Demonstrate the means by which new customer and distribution devices could interoperate with PG&Es Advanced Metering Infrastructure (AMI) network (IPv6).

iv. Scope
- Demonstrate the methodology, protocols, and standards for customers and vendors to connect and communicate various new devices and applications (e.g., Home Area Network (HAN), Electric Vehicle (EV) charging, smart appliances, etc.) with the AMI network (IPv6) in an effective manner.

v. Deliverables
- Conduct lab testing that will certify customer open architecture devices/applications that are AMI compatible, secure and interoperable.
- Provide physical and application interfaces, as a Proof of Concept, which will permit customer and third party devices to connect to our AMI network(s).

vi. Metrics
- 3f. Improvements in system operation efficiencies stemming from increased utility dispatchability of customer demand side management
- 5i. Increase in the number of nodes in the power system at monitoring points
- 7j. Provide consumers with timely information and control options

vii. Schedule
- 2 years

viii. EPIC Funds Encumbered
- $0

ix. EPIC Funds Spent
- $265

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)
- TBD

xv. Status Updates
- Project is in Plan/Analyze Phase.

- Next steps are to review and approve business plan, develop use cases, then design, build, and test.

Project #2.27 Next Generation Integrated Smart Grid Network Management

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- Grid Operations/Market Design; Distribution; Demand-side Management

iii. Objective
- Evaluate new technologies to holistically monitor, control and evolve the communications network and supporting infrastructure as a platform to enable Smart Grid solutions.

iv. Scope
- Demonstrate a new Advanced Metering Infrastructure (AMI) Network management system to holistically monitor, control, and evolve the existing AMI network and infrastructure from a billing-centric platform to a fully operational AMI solutions platform that will meet evolving customer and grid needs

v. Deliverables
- Demonstrate an integrated, multi-tenant network management system that may include the following features:
    - Integrated network management & control that will monitor and prioritize data traffic
    - Automate trouble ticketing creation process
    - Workflow management
    - Asset management of meter and network equipment regardless of meter or network types
    - Business continuity planning to streamline maintenance and operations

vi. Metrics
- 3a. Maintain / Reduce operations and maintenance costs
- 5a. Outage number, frequency and duration reductions
- 5d. Public safety improvement and hazard exposure reduction
- 5e. Utility worker safety improvement and hazard exposure reduction

vii. Schedule
- 2 years

viii. EPIC Funds Encumbered
- $58,658

ix. EPIC Funds Spent
- $66,706

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)

- TBD

xiv. Treatment of Intellectual Property (if applicable)

- TBD

xv. Status Updates

- Project is in Plan/Analyze Phase.
- Developed business plan and use cases.
- Next steps are to complete competitive bid process, evaluate and select vendor(s) and launch design, build and test phases.

Project #2.28 Smart Grid communications path monitoring

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Grid Operation/Market Design

iii. Objective
   - Evaluate more efficient communication paths for AMI-related messages, including methods to clear potential interference, congestion, validate proper authorizations, and grant clearances for sending message over a secured communication path.

iv. Scope
   - Project scope being further evaluated - TBD

v. Deliverables
   - Project deliverables being further evaluated - TBD

vi. Metrics
   - TBD

vii. Schedule
   - Project schedule being further evaluated - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)
   - TBD

xv. Status Update
   - Project is currently on-hold.

Project #2.29 Mobile Meter Applications

i. Investment Plan Period
- 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
- Grid Operations/Market Design; Distribution; Demand-Side Management (DSM)

iii. Objective
- Demonstrate the utility's ability to enable dynamic electric mobile metering.

iv. Scope
- Develop and test a mobile meter prototype on various applications that can be used to capture and monitor real-time energy transactions and usage (e.g. plug-in electric vehicles (PEVs), Distributed Generation (DG), mobile storage, etc.).
- Monitor the grid impact of knowing when, where, and what size load will be necessary to support new, flexible location technologies such as: PEVs, mobile distributed generation, and mobile storage.

v. Deliverables
- Design specification of mobile meter.
- Demonstration of mobile meter hardware prototype.
- End-to-end meter to cash testing using existing AMI or cellular based network.
- Lab testing of use cases on DG applications and PEV metering, including remote and near real-time tracking of vehicle charge locations and energy flow.

vi. Metrics
- 3a. Maintain / Reduce operations and maintenance costs (Affordability)
- 7b. Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (Reliability)
- 7j. Provide consumers with timely information and control options (Customer)

vii. Schedule
- 2 years

viii. EPIC Funds Encumbered
- $74,827

ix. EPIC Funds Spent
- $261,155

x. Partners (if applicable)
- TBD

xi. Match Funding (if applicable)
- TBD

xii. Match Funding Split (if applicable)
- TBD

xiii. Funding Mechanism (if applicable)
- TBD

xiv. Treatment of Intellectual Property (if applicable)
- TBD

xv. Status Updates

- Project is in Plan/Analyze Phase.
- Developed specification for Next Generation Mobile Meter that covers various test use cases (EV charging stations, EVs, and DG).
- Next steps are to complete competitive bid process for vendor selection, develop Next Generation Meter prototype, and begin testing.

Project #2.30 Leverage EPIC funds to participate in industry-wide RD&D programs

i. Investment Plan Period
   - 2nd Triennial (2015-2017)

ii. Assignment to Value Chain
   - Grid Operations/ Market Design; Transmission; Distribution; Demand-side Management

iii. Objective
   - Leverage EPIC dollars by participating and collaborating in multi-utility, industry-wide research, demonstration and deployment initiatives conducted by third-party organizations

iv. Scope
   - Project scope being further evaluated - TBD

v. Deliverables
   - Project deliverables being further evaluated - TBD

vi. Metrics
   - TBD

vii. Schedule
   - Project schedule being further evaluated - TBD

viii. EPIC Funds Encumbered
   - $0

ix. EPIC Funds Spent
   - $0

x. Partners (if applicable)
   - TBD

xi. Match Funding (if applicable)
   - TBD

xii. Match Funding Split (if applicable)
   - TBD

xiii. Funding Mechanism (if applicable)
   - TBD

xiv. Treatment of Intellectual Property (if applicable)
   - TBD

xv. Status Updates
   - Project is currently on-hold.

5. Conclusion

a. Key Results for the year for PG&E EPIC Programs

Throughout the course of 2015, PG&E's EPIC 1 and 2 Programs have made significant progress and achieved noteworthy successes on many of the projects. Of the 33 active projects across EPIC 1 and EPIC 2, fifteen are in the Plan/Analyze Phase, four are in the Design/Engineering Phase, nine are in the Build/Test Phase, one is in the Staging Phase, three are in the Close-out Phase, and one is complete.

The progress and achievements of these projects have been identified in the Project Status Report found in Appendix A. In 2015, a number of projects have achieved significant milestones, including but not limited to the following:

- **Project 1.01 - Energy Storage for Market Operations** successfully followed CAISO market awards on an automated basis;
- **Project 1.08 - Distribution System Safety and Reliability through New Data Analytics Techniques** demonstrated a visualization tool that calculates asset risk based on an integrated data set from multiple data sources;
- **Project 1.16 - Vehicle-to-Grid Operational Integration**, successfully supported the Valley and Butte fire response, generating power for two days at a Red Cross shelter and a local church for housing evacuees.

Since the inception of the EPIC program, PG&E has established strong Program Management practices to provide oversight of the EPIC program. In addition to oversight, the Program Management provides:

- Communications with interested vendors and suppliers through channels such as referrals and industry events (e.g., Grid Edge Executive Council, Silicon Valley Leadership Group, DistribuTECH, etc.).
- Coordination with the other IOUs and CEC through regular administrator calls and collaboration.
- Administrator-coordinated execution of industry-wide EPIC workshops and symposiums.
- Other EPIC program support, such as providing comments to select CEC Program Opportunity Notices (PONs).

PG&E's EPIC portfolio of active projects continue to address challenges of the changing grid landscape, including an increase in renewable adoption by our customers, declining battery costs, more affordable electric vehicles, etc. These developments in the marketplace requires a focus on enhanced data analytics and forecasting approaches, effectively addressing two-way power flow, and extracting value from DERs. These achievements from the EPIC projects and their future project plans help pave the way for the grid of the future, addressing upcoming challenges of a changing grid landscape and, ultimately, improving the safety, reliability and affordability of the electric grid.

b. Next Steps for EPIC Investment Plan

PG&E, in conjunction with the other EPIC Administrators, hosted stakeholder workshops, and symposiums with accompanied webinars. The workshop and symposium took place on August 18, 2015 and December 3, 2015, respectively. These industry events focused on the sharing progress, results, and future plans, improving coordination and understanding among administrators, parties, and the Commission, raising awareness and visibility of EPIC investments, and promoting program transparency.

In 2016, PG&E and Administrators will continue to host a workshop and symposium to achieve the above stated goals. PG&E will also continue to promote the EPIC program through participation in both internal and external public forums, such as industry events and taking vendor and supplier referrals.

Additionally, PG&E anticipates the closure of many EPIC 1 projects in 2016 and eagerly anticipates sharing its findings via the projects' final reports.

c. Issues That May Have Major Impact on Progress in Projects

Inherent to the RD&D nature of the EPIC program, the market dynamics can change rapidly. Some potential reasons that can impact the projects' progress include:

- Changes in the market place have made the project obsolete (or relatively less attractive)
- Different technologies have emerged that could produce the desired results at a lower cost, so the original project is no longer a compelling use of funds
- The technology may prove to not yet be ready for commercialization
- The vendor interest may drop due to the small-scale pilot size of the project or they may revise business model that is no longer aligned with the projects' objectives

Furthermore, while the more obvious goal of technology demonstration is to help advance the pre-commercial technologies to market, there are related goals, which include determining the clean technology areas that are feasible for additional study and investment versus the areas that should no longer be pursued. In some cases, success may be defined by determining a conclusion about a lack of commercial scalability for the technology prior to spending the entire amount for which the project was budgeted.

PG&E is mitigating some of this risk by managing the EPIC projects and phases with a stage-gated approach, providing an off-ramp for projects if they are deemed no longer efficient uses of funds.

PACIFIC GAS AND ELECTRIC COMPANY

APPENDIX A

PROJECT STATUS REPORT

(SEE SPREADSHEET ATTACHED)

APPENDIX A
PACIFIC GAS AND ELECTRIC COMPANY
ELECTRIC PROGRAM INVESTMENT CHARGE
2013 ANNUAL REPORT

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief description of the project - Objective	Brief description of the project - Scope	Brief description of the project - Deliverables
	A	B	C	D	E1	E2	E3
1	1st Triennial (2012-2014)	PG&E	1.01 Energy Storage for Market Operations	Renewables/DER Resource Integration	• Develop technologies and strategies for efficient and optimized bidding and scheduling of Energy Storage Technologies (ESTs) in California ISO markets and demonstrate those strategies using PG&E's existing Sodium Sulfur Battery Energy Storage Systems (NaS BESS). • This project contributes to objectives in the following CPUC proceeding(s): Energy Storage OIR R.15-03-011.	• Develop and deploy technology to enable fully automated resource response to CAISO market awards. • Quantify the values that battery resources can capture in CAISO markets. • Inform Cost Effectiveness Models. • Provide Guidance on Regulatory Compliance.	• Demonstrate automated and remote control application for generic energy storage resources to interface with existing SCADA systems. • Report financial performance from participation in CAISO markets. • Report comparison of actual performance vs. hypothetical performance quoted in industry reports. • Comply with regulatory requirements and establish a framework/recommendations for accounting standards applicable to energy storage.
2	1st Triennial (2012-2014)	PG&E	1.02 Energy Storage for Distribution Operations	Renewables/DER Resource Integration	• Demonstrate the ability of a utility operated energy storage asset to address capacity overloads on the distribution system and improve reliability. • This project contributes to objectives in the following CPUC proceeding(s): Energy Storage OIR: R.15-03-011.	• Deploy utility operated energy storage asset at a single site • Demonstrate peak shaving use case along with other site-specific use cases as suggested by distribution operators	• Identify energy storage site based on project objectives • Identify an economic modeling tool to compare the planned traditional utility with alternatives using distributed resources or demand-side investments • Construct and integrate energy storage system • Test system and analyze results to prove project objectives
3	1st Triennial (2012-2014)	PG&E	1.03 Mobile and Stationary Energy Storage Synergies	Renewables/DER Resource Integration	The project aims to reduce existing barriers to deployment of battery energy storage systems by demonstrating whether post-electric vehicle (EV) "second life" batteries can cost-effectively perform electric distribution services. The project will demonstrate the potential for reduced energy storage system costs via a) the development of an integration platform for deploying such batteries (Phase I) and b) the use of lower cost "second life" batteries in the integrated platform (Phase 2).	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD
4	1st Triennial (2012-2014)	PG&E	1.04 Expand test lab and pilot facilities for new energy storage systems. Formally Withdrawn. CPUC A.12-11-003, 10/15/2013.	Renewables/DER Resource Integration	N/A	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief description of the project - Objective	Brief description of the project - Scope	Brief description of the project - Deliverables
	A	B	C	D	E1	E2	E3
5	1st Triennial (2012-2014)	PG&E	1.05 New Forecast Methods for Improved Storm Damage Modeling	Renewables/DER Resource Integration	Demonstration of emerging capabilities in mesoscale modeling to provide more granular and accurate weather forecasting input to PG&E's storm damage prediction model, and to other PG&E forecasting applications, like catastrophic wildfire risk and PV generation. The main goal is more effective and granular damage prediction, and therefore more efficient response to storm events.	• Project focus is on development, deployment, and implementation of an operational version of the Weather Research and Forecasting (WRF) mesoscale model to support PG&E's forecasting program. • Not in scope for this project is enhancements to PG&E's Restoration Work Plan other than improved forecast damage numbers.	Fully functional mesoscale modeling system known as POMMS (PG&E Operational Mesoscale Modeling System) that will provide the following: • Detailed weather input into PG&E's damage prediction modeling system (SOPP). • Next generation wildfire threat awareness system. • Historical and forecast solar irradiance data to internal PG&E stakeholders.
6	1st Triennial (2012-2014)	PG&E	1.06 Demonstrate communication systems allowing the CAISO to utilize available renewable generation flexibility	Renewables/DER Resource Integration	This project would demonstrate the use of accepted communications protocols to allow the CAISO to send an operating signal to reduce output under specified conditions, as allowed by contracts.	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD
7	1st Triennial (2012-2014)	PG&E	1.07 Demonstrate systems to ramp existing gas-fired generation more quickly to adapt to changes in variable energy resources output. Formally Withdrawn. CPUC A.12-11-003.	Renewables/DER Resource Integration	N/A	N/A	N/A
8	1st Triennial (2012-2014)	PG&E	1.08 Distribution System Safety and Reliability through New Data Analytics Techniques	Grid Modernization and Optimization	Develop and demonstrate a new data analytics technique to improve distribution system safety and reliability. The project specifically developed and tested a System Tool for Asset Risk (STAR), which is an enterprise software application that Electric Operations will use to calculate and display (graphically and geospatially) risk scores for electric transmission, substation and distribution assets. The STAR will enable an automated, system-wide application to improve risk identification, prioritization, and investment decisions to support electric system safety.	• Demonstrate whether the ever-increasing amounts of data can be mined and combined for targeted, cost-effective use for improved asset management. • Potential scenarios include risk-based asset management, safety hazard mitigation and proactive outage prediction using self-serve and virtual integration environments.	• Overview of existing applications and data sources • Assessment of existing data source quality • High-level future business processes by functional area • Inventory of asset risk algorithms (formulas or complexity) for "In Scope" asset classes • High-level Change Management Approach • Prioritized and phased implementation plan • Cost estimate for full implementation of the STAR project • Proof of concept prototype
9	1st Triennial (2012-2014)	PG&E	1.09A Close proximity switching	Grid Modernization and Optimization	This project explores and seeks to discover effective, new tools to safely operate "Solid Blade in Oil Rotatory Switches."	• Test new tools and techniques for safe operation of Solid Blade in Oil Rotatory Switches. • Evaluate alternatives to decrease probability of injury to workers and public. • Help design a robotic tool to allow remote operation. • Develop the necessary parts / adaptors to be used on various types (manufacturer, brand, age, etc.) of Solid Blade in Oil Rotatory Switches.	A working prototype for the various Solid Blade in Oil Rotatory Switch tools.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief description of the project - Objective	Brief description of the project - Scope	Brief description of the project - Deliverables
	A	B	C	D	E1	E2	E3
10	1st Triennial (2012-2014)	PG&E	1.09B and 1.10B - Network Conditioned-Based Maintenance	Grid Modernization and Optimization	The project focus is on development, testing, deployment, and implementation of new technologies, construction methods and techniques, and cost reduction techniques in support of the Supervisory Control and Data Acquisition (SCADA) monitoring systems used on the Distribution Networks. The monitoring system consists of a complex and extensive set of components used to assess the health and condition of the network transformers on a continuous basis. This research is looking at potential failure points on the monitoring system components and what technologies and improvements can be applied to increase life expectancy of these components and reduce production and maintenance costs for this system and similar systems.	• Assess new technologies and feasibility of application on the Distribution Networks. • Primary focus on technologies, components and work methods to extend the life expectancy of monitoring systems equipment and reduce long term maintenance costs.	• Modified or improved components identified for use on Distribution Network Monitoring System. • Improved installation and construction work methods. • Economic model for maintenance variables based on life expectancy testing of components. • Changes to components.
11	1st Triennial (2012-2014)	PG&E	1.09C Discrete Reactors	Grid Modernization and Optimization	Gain operating experience with Discrete Series Reactors to determine whether such devices would be cost effective and operate reliably and safely on PG&E's transmission system.	• Install and test 90 DSR units on the Las Positas-Newark 230 kV line • Install and test Server at PG&E's San Francisco General Office (SFGO) headquarters, complete with Smart Wire System Manager Software • Communication links between the DSRs and server to support the DSR monitoring and control.	• Installation, testing and analysis of DSR and server communication links • Job Estimate to engineer, procure, construct and test the DSRs • White paper describing project including go/no go recommendation • Final report describing overall project, including finding from the operations and testing of DSR units and a recommendation as to whether or not to install the DSRs elsewhere in the PG&E system
12	1st Triennial (2012-2014)	PG&E	1.10A Dissolved Gas Analysis	Grid Modernization and Optimization	Develop tools and algorithms that analyze data from monitoring equipment installed on substation equipment (distribution and transmission) that tests for dissolved gasses or other precursor data that would assist in understanding the condition of the equipment.	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD
13	1st Triennial (2012-2014)	PG&E	1.10C Underground Cable Analysis	Grid Modernization and Optimization	Develop tools and algorithms that analyze load and operating characteristic data from underground cables in order to develop an understanding of potential failure points, cable maintenance needs, and cable life expectancy.	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD
14	1st Triennial (2012-2014)	PG&E	1.11 Demonstrate self-correcting tools to improve system records and operations	Grid Modernization and Optimization	Demonstrate tools that identify and "register" existing assets to improve the integration between utility planning and operations. As part of the demonstration, implement "self-correcting" technologies that identifies plan vs. actual discrepancies and updates system records automatically. High priority use cases include: (1) Mapping of transformers to primary phase, (2) Mapping of customers to transformers and (3) Precision mapping of PG&Es overhead and underground network.	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD
15	1st Triennial (2012-2014)	PG&E	1.12 Demonstrate New technologies that improve wildlife safety and protect assets from weather-related degradation	Grid Modernization and Optimization	Demonstrate new strategies and technologies to improve animal and bird protection, reduce outages caused by animals and birds, and protect assets from expensive weather-related degradation such as fog related corrosion.	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief description of the project - Objective	Brief description of the project - Scope	Brief description of the project - Deliverables
	A	B	C	D	E1	E2	E3
16	1st Triennial (2012-2014)	PG&E	1.13 Demonstrate new communication systems to improve substation automation and interoperability	Grid Modernization and Optimization	Demonstrate new strategies and technologies to convert and integrate multiple existing proprietary technologies within the substation environment for more effective operations. Substation are key operational hubs and represent significant investments, which must be further leveraged by engaging with vendors to create the next generation of interoperable substation services and products.	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD
17	1st Triennial (2012-2014)	PG&E	1.14 Next Generation SmartMeter Telecom Network Functionalities	Grid Modernization and Optimization	This project explores and discovers effective new network applications and devices to leverage and improve the SmartMeterTM communications network.	Leverage the existing SmartMeter™ network to support additional applications. Inform future uses of the SmartMeter™ network as to message capability, security, latency, and engineering constraints. Specifically focus on: • Test new devices to support network functions and capabilities not previously envisioned (e.g., new data streams, faster data collection) • Evaluate alternatives to decrease future upgrade, maintenance and/or operational costs • Demonstrate different network applications, each focused on separate use cases	• Evaluate new applications and devices, their associated data traffic impact on the SmartMeter™ network, and recommend which items warrant consideration for full-scale deployment. • Develop business case based on findings for full deployment consideration.
18	1st Triennial (2012-2014)	PG&E	1.15 Grid Operations Situational Intelligence	Grid Modernization and Optimization	• The objective of this pilot is to develop and pilot a real-time data visualization software platform for use by Electric Distribution Operations end users. Data will be integrated from various data sources and displayed on Distribution Control Center video walls and individual desktop computers, with potential for future scalability to handheld devices. • This visualization tool may provide situational intelligence for a variety of end users outside of the Distribution Control Center, including the Emergency Operations Center, Grid Control Center, and potentially crews in the field as well. • This project contributes to objectives in the following CPUC proceeding(s): DRP R.14-08-013 / A. 15-07-006.	• Scope includes the integration of data (network model, loading, SmartMetersTM, outages, fire, weather, etc.) and a real-time data visualization platform for Distribution Operations. • The Distribution Management System (DMS) platform and predictive analytics are not included in the scope.	• Demonstrate Real-time Data Visualization Platform, including data integration from a variety of data sources and a visual interface that includes geospatial, list, and trending layers.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief description of the project - Objective	Brief description of the project - Scope	Brief description of the project - Deliverables
	A	B	C	D	E1	E2	E3
19	1st Triennial (2012-2014)	PG&E	1.16 Vehicle-to-grid Operational Integration	Grid Modernization and Optimization	• Leverage plug-in hybrid vehicle technology emerging in PG&E fleet to generate utility-grade power, supporting distribution circuits during planned or unplanned outage events.	Develop nominally 120kW exportable power capabilities from a plug-in hybrid electric truck. Seek to create the protocols necessary to safely connect the truck to the appropriate grid connection points. The portfolio of fleet vehicles (higher and lower weight classes) may broaden the range of available power ratings demonstrated by the project.	• Develop operating requirements for the vehicle. • Understand engineering challenges with high power export with collaborative supplier development to solve. • Develop safety and interconnection protocols to connect the vehicle to the grid leveraging existing protocols for temporary local generator set connection. • Define and document power requirements for different outage/usage scenarios. • Develop operating protocols (when and how the vehicles will be used). • Develop unplanned outage protocols. • Develop the hardware and software (if required) to connect the vehicle to PG&E's system. • Build vehicles for field testing.
20	1st Triennial (2012-2014)	PG&E	1.17 Industry participation to leverage EPIC dollars	Grid Modernization and Optimization	PG&E can leverage EPIC dollars by participating and collaborating in multi-utility industry-wide research initiatives conducted by third party organizations experienced in the RD&D area.	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD
21	1st Triennial (2012-2014)	PG&E	1.18 Appliance-Level Load Disaggregation	Customer Service and Enablement	This project focuses on delivering the cost by major appliances to customers.	This project will use the data enabled by the SmartMeter™ platform to provide appliance-level itemization of monthly bill charges to customers, without their completing any audit or subscribing to any new service. This project assumes that minute level meter data is available.	• Quantify disaggregation accuracy and compare vendors. • Based on results, provide recommendations for deployment strategy of appliance-level billing.
22	1st Triennial (2012-2014)	PG&E	1.19 Enhanced Data Techniques and Capabilities via the SmartMeter™ Platform	Customer Service and Enablement	The project is to explore and discover effective, new data that can be collected and studied for further benefits. Demonstrate the type of additional data that can be collected and/or processed through the SmartMeterTM platform. Evaluate impact of any increased data traffic on the SmartMeterTM network. Focus on new data collection that makes the SmartMeter platform more robust for more customers.	Demonstrate the collection of new data from SmartMeters™. Example use cases include: • Power Quality Data (C12.19 format) • Mobile data collection methods • Power theft detection methodology using SmartMeter data for revenue assurance purposes	• Evaluate new data and analytic methodologies, their associated impact on the SmartMeter™. • Recommendation of which data warrants consideration for full-scale deployment. • Evaluation should provide key inputs to a business case for general deployment.
23	1st Triennial (2012-2014)	PG&E	1.20 Demonstrate the benefits of providing the competitive, open market with automated access to customer-authorized SmartMeter™ data to drive innovation.	Customer Service and Enablement	N/A	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief description of the project - Objective	Brief description of the project - Scope	Brief description of the project - Deliverables
	A	B	C	D	E1	E2	E3
24	1st Triennial (2012-2014)	PG&E	1.21 Automatic Identification of Distributed Photovoltaic (PV) Resources	Customer Service and Enablement	• This project aims to validate and integrate a software platform to identify photovoltaic (PV) resources by leveraging Smart Meter data. This project focuses on addressing the issue of unauthorized interconnections in an automated fashion by developing and algorithm to identify resources, including integration with PG&E billing and interconnection database, as well as develop an automated outreach system for identified customers. • This project contributes to objectives in the following CPUC proceeding(s): Interconnection R. 11-09-011 Rule 21.	• Identify vendor to develop or pilot software • Develop integration and communication platform for auto-identification of Unauthorized Interconnections (UIs) • Demonstrate ability to automatically integrate software with billing and interconnection	• Successful integration of software with PG&E's Customer Care and Billing (CC&B) system. • Successful tracking of all UIs identified. • Successful tracking of communication and "conversion" of UIs to interconnection.
25	1st Triennial (2012-2014)	PG&E	1.22 Electric Vehicle Submetering	Customer Service and Enablement	• EV submetering pilot to test subtractive metering process and Electric Vehicle Service Provider (EVSP) business models. This project addresses CPUC D.13-11-008, which requires PG&E, along with the other two CA IOUs, to pursue a submetering pilot and eventual protocol. • This project contributes to objectives in the following CPUC proceeding(s): EV D.13-11-008.	EV submetering pilot will entail EVSPs delivering submeter data to IOU for subtraction from customer's primary meter to create an EV and a house bill. Customer will be responsible for both bills. In Phase 2, EVSP will be responsible for the bill.	• Process to receive EVSP submetered data. • Process to subtract EV data from primary meter to create two bills. • Inclusion of EV portion of bill on customer's monthly bill. • Obtain 3rd party evaluator for both phases of pilot through a Request for Proposal (RFP). • Incentive payments to EV Meter Data Management Agents (MDMA).
26	1st Triennial (2012-2014)	PG&E	1.23 Photovoltaic (PV) Submetering	Customer Service and Enablement	• Initiative to obtain additional unnetted PV data to support customer call center bill experience, and provide additional service to its customers. PV generation data will be integrated with existing MyEnergy web portal for customers' benefit. • This project contributes to objectives in the following CPUC proceeding(s): DG R.12-11-005.	Explore four different methods for obtaining PV generation data (Dedicated smart meter, submeter communication via ZigBee radio, 3rd party estimates, and data exchange with solar companies, and work with vendor to relay data to customer.	• Implement pilot program for dedicated smart meters and third party estimates. • Explore opportunities for submetering technology and solar company data exchange. • Modify existing Customer Data Warehouse (CDW)/MyEnergy interface to allow for additional data streams and visualization. • Evaluate relative merits of various generation measurement/estimation approaches.
27	1st Triennial (2012-2014)	PG&E	1.24 Demand-Side Management (DSM) for Transmission and Distribution (T&D) Cost Reduction	Customer Service and Enablement	• Assess how to best utilize DSM resources to create a targeted customer- and location-specific approach to assist with distribution capacity constraints. • This project contributes to objectives in the following CPUC proceeding(s): DRP R.14-08-013 / A. 15-07-006.	• Improve ability to estimate Heating, Ventilation and Air Conditioning (HVAC) direct load control load impacts at the distribution feeder level to aid in better understanding of the localized impact of HVAC direct load control devices on meeting distribution feeder level reliability concerns.	• Deploy data logging devices on a scientific sample of existing SmartAC Cycling customers, to enable real time monitoring of device performance and load impacts at feeder-level. • Develop infrastructure to make real-time data available on feeder-level load impacts of SmartAC Cycling to distribution operations. • Produce report describing a case study methodology of targeting and valuing customer side peak load reductions at the feeder level.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief description of the project - Objective	Brief description of the project - Scope	Brief description of the project - Deliverables
	A	B	C	D	E1	E2	E3
28	1st Triennial (2012-2014)	PG&E	1.25 Direct Current (DC) Fast Charging Mapping	Customer Service and Enablement	Develop, pilot, and validate approaches that help determine the optimal location of direct current (DC) fast chargers based on traffic patterns and distribution grid infrastructure.	Acquire travel pattern data and grid infrastructure capability data to identify low-cost, high utilization areas in which to integrate DC fast chargers into PG&E's distribution system.	• Develop a process to identify optimal DC fast charging sites. • Develop a map that presents the locations of optimal DC fast charging sites in a meaningful manner to customers.
29	1st Triennial (2012-2014)	PG&E	1.26 Pilot measurement and telemetry strategies and technologies that enable the cost-effective integration of mass market Demand Response (DR) resources into the CAISO wholesale market	Customer Service and Enablement	Develop, pilot and validate approaches and technologies that enable the cost-effective integration (specifically, the measurement and telemetry) of mass market DR resources into the CAISO wholesale market. While other DR projects focus on integration of DR resources into various utility and future ISO operational needs, this project intends to test alternative telemetry solutions and technologies to satisfy CAISO operational visibility requirements.	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD
30	2nd Triennial (2015-2017)	PG&E	2.01 Evaluate storage on the distribution grid	Renewables/DER Resource Integration	Identify and evaluate whether system needs can be cost-effectively addressed with energy storage, including identifying a range of storage deployment locations and grid interconnection requirements on a granular level.	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD
31	2nd Triennial (2015-2017)	PG&E	2.02 Pilot Distributed Energy Management Systems (DERMS)	Renewables/DER Resource Integration	• Demonstrate new technology to monitor and control DERs to manage system constraints and evaluate the potential value of DER flexibility to the grid. The DERMS pilot will drive learning about the people, process, and technology needed to operate the high DER penetration grid of 2025. • Create, test, and iterate on future DERMS requirements (e.g., communication requirements for PG&E and 3rd party owned DERs) • Learn about business process change and personnel skills & knowledge needed to implement DERMS • Enable informed choice for long-term strategic vendor in 2017 and beyond (pilot is not choosing the long term vendor) • This project contributes to objectives in the following CPUC proceeding(s): DRP R.14-08-013 / A. 15-07-006.	• Demonstrate minimum viable DERMS operation at PG&E to address key DER management use cases. • The demonstration will take place in a limited geography with a diverse set of DERs being monitored and controlled by the pilot DERMS.	The functional integration of a DERMS software minimum viable product and operational demonstration of the identified use cases. A report that: • Determines the most important characteristics of a full deployment solution including detailed functional and technical requirements • Identifies best practices and required internal capabilities for a full deployment solution • Develops operational processes that can be scaled to a wider system deployment • Defines boundaries and integrations with other PG&E systems (e.g., DRMS, DMS, market systems) • Develops a point of view on the utility role in managing DERs for grid and economic benefits

APPENDIX A
PACIFIC GAS AND ELECTRIC COMPANY
ELECTRIC PROGRAM INVESTMENT CHARGE
2013 ANNUAL REPORT

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief description of the project - Objective	Brief description of the project - Scope	Brief description of the project - Deliverables
	A	B	C	D	E1	E2	E3
32	2nd Triennial (2015-2017)	PG&E	2.03A Test Smart Inverter Enhanced Capabilities - Photovoltaics (PV)	Renewables/DER Resource Integration	•This project will explore the use and impact of aggregated customer-sited smart inverters to help inform emerging industry standards, as well as define the operational and communication requirements to support the advancement and deployment of new inverter technologies. • This project contributes to objectives in the following CPUC proceeding (s): DRP R.14-08-013 / A. 15-07-006.	• This project will leverage the results of the lab testing of smart inverter functionalities that is being completed by PG&E's Smart Grid Pilot Volt/Var Optimization (VVO) Project at PG&E's Applied Technologies Lab (as specified by the Smart Inverter Working Group). • This EPIC project will deploy smart inverters on one or more feeders to evaluate their effectiveness in improving PV integration and mitigation safety risks.	• Identify feeder(s) where smart inverters will be installed for demonstration. • Demonstrate the use of smart inverters on one or more feeders to demonstrate the inverters' local voltage control capabilities and impacts related to high penetration of customer-sited solar PV. • Develop any necessary communications software/hardware/technologies between the utility and 3rd party aggregator or end devices. • Evaluate the performance of smart inverters.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief description of the project - Objective	Brief description of the project - Scope	Brief description of the project - Deliverables
	A	B	C	D	E1	E2	E3
33	2nd Triennial (2015-2017)	PG&E	2.03B Test Smart Inverter Enhanced Capabilities - Electric Vehicle (EV)	Renewables/DER Resource Integration	• As a complement to the smart inverter assessment related to Photovoltaics (PV) in project 2.03A. Smart Inverters for PV, this project will asses the use and impact of EV energy flow capabilities, as required by D.15-04-020. • This project contributes to objectives in the following CPUC proceeding: DRP R.14-08-013 / A. 15-07-006.	• This EPIC project will enable dispatchable charging and discharging of the EV in response to an Open Automated Demand Response (OADR) event signals. Varied test modes will be tested.	• Evaluation of the performance of the EV in response to OADR signals and impacts on energy flow capabilities.
34	2nd Triennial (2015-2017)	PG&E	2.04 DG monitoring & voltage tracking	Renewables/DER Resource Integration	• This project aims to utilize the voltage measurement capabilities of smart meters to monitor DG output and identify voltage fluctuations caused by the intermittent nature of distributed renewable resources. Project will use data analytics techniques and Advanced Metering Infrastructure (AMI) (and other) data to determine the impact of PV penetration on Rule-2-violations and create a rating for the probability that a Rule 2 violation is caused by DG. • This project contributes to objectives in the following CPUC proceeding(s): DRP R.14-08-013 / A. 15-07-006.	• Create an algorithmic process output rating on the likelihood of a voltage violation (on a given transformer) being caused by DG fluctuations.	• Develop an analytics process / algorithm to analyze AMI and other data for high penetration DG feeders, as well as some low penetration feeders for baselining. • Evaluate impact of DG penetration on voltage.
35	2nd Triennial (2015-2017)	PG&E	2.05 Inertia response emulation for DG impact improvement	Renewables/DER Resource Integration	Demonstrate the capability to emulate inertia injection and support primary frequency control using energy storage and smart inverter technologies to potentially mitigate the impacts of large-scale DG to the grid, improve the grid performance and reliability, and advance California energy policy to increase the amounts of renewable and distributed generation on the grid.	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD
36	2nd Triennial (2015-2017)	PG&E	2.06 Intelligent Universal Transformer (IUT)	Renewables/DER Resource Integration	The project objective is to develop and demonstrate a solid-state transformer field prototype Medium Voltage Fast Charger (MVFC) system, as an application use case of solid-state transformers for DC fast charging of plug-in electric vehicles (PEV), featuring intelligent controls and multiple fast charging of PEVs.	Test demonstration and communication to the same DC solid-state transformer with two protocols.	Demonstrate a proof of concept that 1) an IUT can be used in lieu of other equipment to connect to Direct Current Fast Charge (DCFC) protocols, and 2) an IUT can communicate back to the utility.
37	2nd Triennial (2015-2017)	PG&E	2.07 Real time loading data for distribution operations and planning	Grid Modernization and Optimization	This demonstration will leverage near real time and interval data to improve feeder modeling, inform load allocation throughout the distribution grid and transformer loading profiles, and identify opportunities to enhance current load forecasting processes for distribution transformers, feeders and substation transformers.	• Current technology does not allow for real time line or transformer loading information without full Supervisory Control and Data Acquisition (SCADA) penetration. • Project will aggregate the meter loading to the transformer level at a higher frequency level.	• Develop a unique loading algorithm and rubrics for determining cost-effective data sources and cadences.
38	2nd Triennial (2015-2017)	PG&E	2.08 "Smart" monitoring and analysis Tools	Grid Modernization and Optimization	Demonstrate strategies and technologies for real time, online monitoring of substation equipment; Demonstrate communication protocols and equipment to support the smart devices; Develop visualization techniques for improved monitoring; and evaluate new vendor technologies that enable data correlation and predictive analysis to better identify and respond to potential safety, reliability and/or operational issues.	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief description of the project - Objective	Brief description of the project - Scope	Brief description of the project - Deliverables
	A	B	C	D	E1	E2	E3
39	2nd Triennial (2015-2017)	PG&E	2.09 Distributed Series Impedance (DSI) (Phase 2)	Grid Modernization and Optimization	Demonstrate congestion mitigation by installing DSIs on parallel transmission facilities to demonstrate the next generation of the Distributed Series Reactor (DSR) devices from the First EPIC Triennial Plan, which may allow for better control of transmission line loading.	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD
40	2nd Triennial (2015-2017)	PG&E	2.10 Emergency preparedness modeling	Grid Modernization and Optimization	• Incorporate natural hazard damage model information into one integrated algorithm/tool, which would provide the ability to quickly estimate the impacts of natural hazards on PG&E facilities to enable faster response and restoration. • Provide the ability to prepare for these hazards by proactively modeling the impacts of potential hazards, to understand system vulnerabilities and restoration resource requirements. • Incorporate work efficiency optimization algorithms to more efficient allocate crews.	Develop optimization algorithms and visualization tool that includes asset locations and conditions with multiple potential hazards, which allows for the aggregation of equipment damage estimates (via damage models, outage information systems, and damage assessments), est. hours to repair, and recommended allocation of work resources to efficiently respond to a natural hazard.	• Complete algorithms that aggregates data from multiple sources to feed into application. • Incorporate multiple algorithms into a proof of concept visualization tool. • Develop recommendation for deployment strategy.
41	2nd Triennial (2015-2017)	PG&E	2.11 New mobile technology & visualization applications	Grid Modernization and Optimization	Demonstrate tailored, advanced mobile applications for PG&E field operations that build upon Grid Operations Situational Intelligence (Project #15) demonstration projects in the EPIC First Triennial Plan as well as existing "baseline" mobile deployments underway.	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD
42	2nd Triennial (2015-2017)	PG&E	2.12 New Emergency management mobile applications	Grid Modernization and Optimization	Develop new mobile applications to enhance PG&E's emergency preparedness and response capabilities.	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD
43	2nd Triennial (2015-2017)	PG&E	2.13 Digital substation/substation automation	Grid Modernization and Optimization	Investigate and evaluate sustainable protection and control technologies for future "digital" substations, which may include testing technologies in a lab setting, and performing a pilot implementation to demonstrate technology adoption and integration with legacy substation protection and control technologies.	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD
44	2nd Triennial (2015-2017)	PG&E	2.14 Automatically map phasing information	Grid Modernization and Optimization	This project aims to explore a variety of pre-commercial analytics and/or hardware options to automatically map 3-phase electrical power information in order to improve the distribution network models. Use of Advanced Metering Infrastructure (AMI) data; Light Detection and Ranging mapping technology; Micro Phasor Measurement Units (PMUs); and hardware at the transformer may provide this automated capability.	Project seeks to improve distribution network models through automatic mapping of 3-phase electrical power information.	• Develop algorithm or novel process to use AMI data and other sources to determine the assignment of Phases to conducting components. • Complete an analysis on the most cost-effective frequency for running such a mapping process.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief description of the project - Objective	Brief description of the project - Scope	Brief description of the project - Deliverables
	A	B	C	D	E1	E2	E3
45	2nd Triennial (2015-2017)	PG&E	2.15 Synchrophasor applications for generator dynamic model validation	Grid Modernization and Optimization	This project will evaluate new Synchrophasor analysis applications that can perform generator dynamic model parameter estimation and validation using disturbance data recorded by the Synchrophasor system. New Synchrophasor applications could perform mandated generator model validation without requiring time- and labor-intensive on-site tests, and could detect subsynchronous resonance and other conditions which can cause generator outages. The objective of this project is to determine if this analysis is accurate and cost-effective on PG&E's system.	Scope is limited to confirming that analysis of Phasor Measurement Unit (PMU) data is equal to costly on-site model validation in the target geography. Scope does not include widespread deployment of PMUs or validation process.	• Install Synchrophasors (or "PMUs") on generators or generator tie-lines, and test new data analysis software applications. • Evaluate the applications' ability to perform generator dynamic model validation by analyzing Synchrophasor data following transient disturbances on the transmission system.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief description of the project - Objective	Brief description of the project - Scope	Brief description of the project - Deliverables
	A	B	C	D	E1	E2	E3
46	2nd Triennial (2015-2017)	PG&E	2.16 Enhanced Synchrophasor analytics & applications	Grid Modernization and Optimization	Demonstrate new techniques to synthesize Synchrophasor data and utilize the data for advanced real-time system applications, such as wide-area monitoring, protection, and control systems, which could help move Synchrophasor applications beyond planning, forensics, and visualization to enhanced wide-area monitoring, protection, and control applications.	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD
47	2nd Triennial (2015-2017)	PG&E	2.17 Geomagnetic Disturbance (GMD) evaluation	Grid Modernization and Optimization	Evaluate system vulnerability to Geomagnetic Disturbance (GMD) by modeling GMD that occurs during a geomagnetic storm and evaluating the impact on transmission lines, interconnection lines, substations and system voltages.	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD
48	2nd Triennial (2015-2017)	PG&E	2.18 Optical instrument transformers and sensors for protection and control systems	Grid Modernization and Optimization	Demonstrate newer technologies, such as optical sensors, as well as strategies and technologies to configure appropriate protection settings, including the coordination required between both new and conventional instrumentation.	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD
49	2nd Triennial (2015-2017)	PG&E	2.19 Enable distributed demand-side strategies & technologies	Customer Service and Enablement	• Demonstrate distributed demand-side technologies and approaches to address local and flexible resource needs. • This project contributes to objectives in the following CPUC proceeding(s): Energy Storage OIR R.15-03-011.	Deploy an aggregation of BTM customer energy storage resource to reduce peak loading or absorb distributed generation on a utility distribution feeder(s).	• Demonstrate and test field results for effectiveness of the use of aggregated customer-sited BTM energy storage resources to peak load reduction reduce peak loading or absorb distributed generation on a utility distribution feeder(s). • Potential to demonstrate communications with aggregate resources for visualization and control. • Evaluate cost-effectiveness and reliability of BTM energy storage for addressing capacity constraints.
50	2nd Triennial (2015-2017)	PG&E	2.20 Real-time energy usage feedback to customers	Customer Service and Enablement	Evaluate innovative feedback technologies to provide near real-time energy usage information to customers and to drive greater customer performance during DR events.	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD
51	2nd Triennial (2015-2017)	PG&E	2.21 Home Area Network (HAN) for commercial customers	Customer Service and Enablement	• This project will demonstrate the application of HAN technology to PG&E's commercial customers. • This project contributes to objectives in the following CPUC proceeding(s): A.11-03-001.	This project will enable the ZigBee HAN radio on Large Commercial and Industrial (LC&I) meters, to facilitate LC&I customer access to real time usage data, as well as testing of the integration with existing Energy Management Systems (EMS).	• Install ZigBee HAN devices with selected LC&I customers and connect devices to SmartMeters. • Monitor customer usage and issue/collect customer and vendor surveys. • Complete report with identified issues and recommendations for how to integrate with an existing EMS.

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief description of the project - Objective	Brief description of the project - Scope	Brief description of the project - Deliverables
	A	B	C	D	E1	E2	E3
52	2nd Triennial (2015-2017)	PG&E	2.22 Demand reduction through targeted data analytics	Customer Service and Enablement	• Identify strategic customers and target demand reduction in local areas by combining and integrating multiple DSM technologies (e.g., Energy Efficiency (EE), Demand Response (DR), Distributed Energy Storage, Consumer-oriented Energy Tools). • Investigate whether PG&E can achieve a sufficient amount of demand reduction, give visibility into the customer-side resources and improve the reliability of customer-side resources at the local level, in order to reschedule local capacity expansion expenditures. • This project contributes to objectives in the following CPUC proceeding(s): DRP R.14-08-013 / A. 15-07-006.	• Develop a solution/tool that determines needed customer demand reduction individually and in aggregate at asset level, leveraging interval and Supervisory Control and Data Acquisition (SCADA) data. • Develop cross-Distributed Energy Resource (DER) customer targeting to address forecasted capacity challenges at specific assets, for specific days and times of year, leveraging interval data and other customer attributes	• Create a data analytics platform capable of combining and analyzing multi-structured data, linking to a variety of data sources. • Develop a method for identification, valuation, implementation, and tracking of targeted DERs. • Create a quantitative screening/rank order tool. • Develop actionable DER recommendations to customer outreach teams for reaching demand reduction goals
53	2nd Triennial (2015-2017)	PG&E	2.23 Integrate demand side approaches into utility planning	Customer Service and Enablement	• This project will enhance PG&E's ability to incorporate the growing usage of DERs into distribution planning tools by developing new customer class load shapes that incorporate DERs and a methodology for modeling DER deployment uncertainty at the circuit level. • This project contributes to objectives in the following CPUC proceeding(s): DRP R.14-08-013 / A. 15-07-006.	Integrate a broader range of customer-side technologies and DER approaches into grid planning and operations in a least cost framework by enhancing distribution load forecasting tools to include new customer load shapes based on the usage of DERs and to model the uncertainty of DER deployment at the circuit level.	• Develop enhanced Customer and DER Load Shapes Catalog in LoadSEER Planning Tool. • Incorporate DER Scenario Projections into LoadSEER. • Develop interface between LoadSEER/CYME for batch processing integration.
54	2nd Triennial (2015-2017)	PG&E	2.24 Appliance level bill disaggregation for non-residential customers	Customer Service and Enablement	Demonstrate the ability to use sub-minute level usage information to determine appliance load for non-residential customers.	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD
55	2nd Triennial (2015-2017)	PG&E	2.25 Enhanced Smart Grid Communications	Cross-Cutting/Foundational	Evaluate license spectrum providers that have developed technologies offered on the Federal Communications Commission (FCC) license frequency range/spectrum.	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD
56	2nd Triennial (2015-2017)	PG&E	2.26 Customer & distribution automation open architecture devices	Cross-Cutting/Foundational	Demonstrate the means by which new customer and distribution devices could interoperate with PG&Es Advanced Metering Infrastructure (AMI) network (IPv6).	Demonstrate the methodology, protocols, and standards for customers and vendors to connect and communicate various new devices and applications (e.g., Home Area Network (HAN), Electric Vehicle (EV) charging, smart appliances, etc.) with the AMI network (IPv6) in an effective manner.	• Conduct lab testing that will certify customer open architecture devices/applications that are AMI compatible, secure and interoperable. • Provide physical and application interfaces, as a Proof of Concept, which will permit customer and third party devices to connect to our AMI network(s).
57	2nd Triennial (2015-2017)	PG&E	2.27 Next generation integrated Smart Grid network management	Cross-Cutting/Foundational	Evaluate new technologies to holistically monitor, control and evolve the communications network and supporting infrastructure as a platform to enable Smart Grid solutions.	Demonstrate a new Advanced Metering Infrastructure (AMI) Network management system to holistically monitor, control, and evolve the existing AMI network and infrastructure from a billing-centric platform to a fully operational AMI solutions platform that will meet evolving customer and grid needs.	• Demonstrate an integrated, multi-tenant network management system that may include the following features: • Integrated network management & control that will monitor and prioritize data traffic • Automate trouble ticketing creation process • Workflow management • Asset management of meter and network equipment regardless of meter or network types • Business continuity planning to streamline maintenance and operations

Row #	Investment Program Period	Program Administrator	Project Name	Project Type	Brief description of the project - Objective	Brief description of the project - Scope	Brief description of the project - Deliverables
	A	B	C	D	E1	E2	E3
58	2nd Triennial (2015-2017)	PG&E	2.28 Smart Grid communications path monitoring	Grid Modernization and Optimization	Evaluate more efficient communication paths for AMI-related messages, including methods to clear potential interference, congestion, validate proper authorizations, and grant clearances for sending message over a secured communication path.	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD
59	2nd Triennial (2015-2017)	PG&E	2.29 Mobile meter applications	Cross-Cutting/Foundational	Demonstrate the utility's ability to enable dynamic electric mobile metering.	• Develop and test a mobile meter prototype on various applications that can be used to capture and monitor real-time energy transactions and usage (e.g. plug-in electric vehicles (PEVs), Distributed Generation (DG), mobile storage, etc.). • Monitor the grid impact of knowing when, where, and what size load will be necessary to support new, flexible location technologies such as: PEVs, mobile distributed generation, and mobile storage.	• Design specification of mobile meter. • Demonstration of mobile meter hardware prototype. • End-to-end meter to cash testing using existing AMI or cellular based network. • Lab testing of use cases on DG applications and PEV metering, including remote and near real-time tracking of vehicle charge locations and energy flow.
60	2nd Triennial (2015-2017)	PG&E	2.30 Leverage EPIC funds to participate in industry-wide RD&D programs	Grid Modernization and Optimization	Leverage EPIC dollars by participating and collaborating in multi-utility, industry-wide research, demonstration and deployment initiatives conducted by third-party organizations	Project scope being further evaluated - TBD	Project deliverables being further evaluated - TBD

APPENDIX A
PACIFIC GAS AND ELECTRIC COMPANY
ELECTRIC PROGRAM INVESTMENT CHARGE
2013 ANNUAL REPORT

Row #	Investment Program Period	Program Administrator	Project Name	Brief description of the project - Schedule	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)
	A	B	C	E4	F	G	H	I	J
1	1st Triennial (2012-2014)	PG&E	1.01 Energy Storage for Market Operations	2.5 years	9/19/2013	No	Grid Operation/Market Design	$616,287	$1,660,000 - $2,030,000
2	1st Triennial (2012-2014)	PG&E	1.02 Energy Storage for Distribution Operations	2.5 years	7/25/2014	Yes	Distribution; Grid Operation/Market Design	$2,039,117	$4,590,000 - $5,610,000
3	1st Triennial (2012-2014)	PG&E	1.03 Mobile and Stationary Energy Storage Synergies	Project schedule being further evaluated - TBD	NA	No	Grid Operation/Market Design	$0	$0
4	1st Triennial (2012-2014)	PG&E	1.04 Expand test lab and pilot facilities for new energy storage systems. Formally Withdrawn. CPUC A.12-11-003, 10/15/2013.	N/A	NA	No	N/A	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Brief description of the project - Schedule	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)
	A	B	C	E4	F	G	H	I	J
5	1st Triennial (2012-2014)	PG&E	1.05 New Forecast Methods for Improved Storm Damage Modeling	3.25 years	9/19/2013	No	Distribution	$461,340	$720,000 - $880,000 (updated in 2015)
6	1st Triennial (2012-2014)	PG&E	1.06 Demonstrate communication systems allowing the CAISO to utilize available renewable generation flexibility	Project schedule being further evaluated - TBD	NA	No	Grid Operation/Market Design	$0	$0
7	1st Triennial (2012-2014)	PG&E	1.07 Demonstrate systems to ramp existing gas-fired generation more quickly to adapt to changes in variable energy resources output. Formally Withdrawn. CPUC A.12-11-003.	N/A	NA	No	N/A	N/A	N/A
8	1st Triennial (2012-2014)	PG&E	1.08 Distribution System Safety and Reliability through New Data Analytics Techniques	2.25 years	9/19/2013	No	Transmission; Distribution	$1,249,505	$2,200,000 - $2,690,000
9	1st Triennial (2012-2014)	PG&E	1.09A Close proximity switching	2.5 years	9/19/2013	No	Transmission; Distribution	$301,808	$900,000 - $1,100,000

Row #	Investment Program Period	Program Administrator	Project Name	Brief description of the project - Schedule	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)
	A	B	C	E4	F	G	H	I	J
10	1st Triennial (2012-2014)	PG&E	1.09B and 1.10B - Network Conditioned-Based Maintenance	3.25 years	9/19/2013	No	Transmission; Distribution	$453,000	$450,000 - $550,000
11	1st Triennial (2012-2014)	PG&E	1.09C Discrete Reactors	3.25 years	9/19/2013	No	Transmission	$1,418,585	$2,490,000 - $3,050,000 (updated in 2015)
12	1st Triennial (2012-2014)	PG&E	1.10A Dissolved Gas Analysis	Project schedule being further evaluated - TBD	NA	No	Transmission; Distribution	$0	$0
13	1st Triennial (2012-2014)	PG&E	1.10C Underground Cable Analysis	Project schedule being further evaluated - TBD	NA	No	Distribution	$0	$0
14	1st Triennial (2012-2014)	PG&E	1.11 Demonstrate self-correcting tools to improve system records and operations	Project schedule being further evaluated - TBD	NA	No	Transmission; Distribution	$0	$0
15	1st Triennial (2012-2014)	PG&E	1.12 Demonstrate New technologies that improve wildlife safety and protect assets from weather-related degradation	Project schedule being further evaluated - TBD	NA	No	Transmission; Distribution	$0	$0

APPENDIX A
PACIFIC GAS AND ELECTRIC COMPANY
ELECTRIC PROGRAM INVESTMENT CHARGE
2013 ANNUAL REPORT

Row #	Investment Program Period	Program Administrator	Project Name	Brief description of the project - Schedule	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)
	A	B	C	E4	F	G	H	I	J
16	1st Triennial (2012-2014)	PG&E	1.13 Demonstrate new communication systems to improve substation automation and interoperability	Project schedule being further evaluated - TBD	NA	No	Transmission; Distribution	$0	$0
17	1st Triennial (2012-2014)	PG&E	1.14 Next Generation SmartMeter Telecom Network Functionalities	3 years	9/19/2013	No	Distribution; Grid Operation/Market Design; Demand-Side Management	$3,110,836	$3,520,000 - $4,300,000
18	1st Triennial (2012-2014)	PG&E	1.15 Grid Operations Situational Intelligence	2.75 years	9/19/2013	No	Distribution; Grid Operation/Market Design; Demand-Side Management	$1,496,446	$3,780,000 - $4,620,000 (updated in 2015)

Row #	Investment Program Period	Program Administrator	Project Name	Brief description of the project - Schedule	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)
	A	B	C	E4	F	G	H	I	J
19	1st Triennial (2012-2014)	PG&E	1.16 Vehicle-to-grid Operational Integration	3 years	9/19/2013	No	Distribution	$1,479,590	$3,600,000 - $4,400,000
20	1st Triennial (2012-2014)	PG&E	1.17 Industry participation to leverage EPIC dollars	Project schedule being further evaluated - TBD	NA	No	Transmission; Distribution	$0	$0
21	1st Triennial (2012-2014)	PG&E	1.18 Appliance-Level Load Disaggregation	2.5 years	9/19/2013	No	Demand-Side Management	$1,043,508	$1,080,000 - $1,320,000
22	1st Triennial (2012-2014)	PG&E	1.19 Enhanced Data Techniques and Capabilities via the SmartMeter™ Platform	3.25 years	9/19/2013	No	Distribution; Grid Operation/Market Design; Demand-Side Management	$1,010,207	$2,600,000 - $3,180,000
23	1st Triennial (2012-2014)	PG&E	1.20 Demonstrate the benefits of providing the competitive, open market with automated access to customer-authorized SmartMeter™ data to drive innovation.	Project schedule being further evaluated - TBD	N/A	N/A	N/A	N/A	N/A

APPENDIX A
PACIFIC GAS AND ELECTRIC COMPANY
ELECTRIC PROGRAM INVESTMENT CHARGE
2013 ANNUAL REPORT

Row #	Investment Program Period	Program Administrator	Project Name	Brief description of the project - Schedule	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)
	A	B	C	E4	F	G	H	I	J
24	1st Triennial (2012-2014)	PG&E	1.21 Automatic Identification of Distributed Photovoltaic (PV) Resources	2.5 years	5/1/2014	Yes	Distribution; Demand-Side Management	$492,485	$1,350,000 - $1,650,000
25	1st Triennial (2012-2014)	PG&E	1.22 Electric Vehicle Submetering	4.75 years Extended by 6 mo. per CPUC request	N/A	No	Distribution; Grid Operation/Market Design; Demand-Side Management	$1,873,328	$2,860,000 - $3,500,000
26	1st Triennial (2012-2014)	PG&E	1.23 Photovoltaic (PV) Submetering	2.5 years	5/1/2014	Yes	Distribution; Grid Operation/Market Design; Demand-Side Management	$928,438	$1,350,000 - $1,650,000
27	1st Triennial (2012-2014)	PG&E	1.24 Demand-Side Management (DSM) for Transmission and Distribution (T&D) Cost Reduction	2 years	5/1/2014	Yes	Transmission; Distribution; Grid Operation/Market Design; Demand-Side Management	$1,196,477	$1,330,000 - $1,620,000

APPENDIX A
PACIFIC GAS AND ELECTRIC COMPANY
ELECTRIC PROGRAM INVESTMENT CHARGE
2013 ANNUAL REPORT

Row #	Investment Program Period	Program Administrator	Project Name	Brief description of the project - Schedule	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)
	A	B	C	E4	F	G	H	I	J
28	1st Triennial (2012-2014)	PG&E	1.25 Direct Current (DC) Fast Charging Mapping	2.5 years	5/1/2014	Yes	Distribution; Demand-Side Management	$285,225	$450,000 - $550,000
29	1st Triennial (2012-2014)	PG&E	1.26 Pilot measurement and telemetry strategies and technologies that enable the cost-effective integration of mass market Demand Response (DR) resources into the CAISO wholesale market	Project schedule being further evaluated - TBD	NA	No	Grid Operation/Market Design and Demand-side Management.	$0	$0
30	2nd Triennial (2015-2017)	PG&E	2.01 Evaluate storage on the distribution grid	Project schedule being further evaluated - TBD	NA	No	Grid Operations/Market Design; Transmission; Distribution; Demand-Side Management	$0	$0
31	2nd Triennial (2015-2017)	PG&E	2.02 Pilot Distributed Energy Management Systems (DERMS)	2 years	1/8/2016	No	Grid Operation/Market Design	$477,287	$ 4,500,000 - $5,500,000

APPENDIX A
PACIFIC GAS AND ELECTRIC COMPANY
ELECTRIC PROGRAM INVESTMENT CHARGE
2013 ANNUAL REPORT

Row #	Investment Program Period	Program Administrator	Project Name	Brief description of the project - Schedule	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)
	A	B	C	E4	F	G	H	I	J
32	2nd Triennial (2015-2017)	PG&E	2.03A Test Smart Inverter Enhanced Capabilities - Photovoltaics (PV)	2.5 years	4/10/2015	No	Distribution; Demand-Side Management	$146,000	$1,890,000 - $2,310,000

Row #	Investment Program Period	Program Administrator	Project Name	Brief description of the project - Schedule	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)
	A	B	C	E4	F	G	H	I	J
33	2nd Triennial (2015-2017)	PG&E	2.03B Test Smart Inverter Enhanced Capabilities - Electric Vehicle (EV)	1.5 years	1/8/2016	No	Distribution; Demand-Side Management	$0	$500,000 - $1,500,000
34	2nd Triennial (2015-2017)	PG&E	2.04 DG monitoring & voltage tracking	1.75 Years	4/10/2015	No	Grid Operation/Market Design	$158,500	$1,700,000 - $2,070,000
35	2nd Triennial (2015-2017)	PG&E	2.05 Inertia response emulation for DG impact improvement	Project schedule being further evaluated - TBD	NA	No	Grid Operations/ Market Design; Transmission	$0	$0
36	2nd Triennial (2015-2017)	PG&E	2.06 Intelligent Universal Transformer (IUT)	2.25 years	9/15/2015	No	Distribution; Grid Operation/Market Design; Demand-Side Management	$0	$1,020,00 - 1,240,000
37	2nd Triennial (2015-2017)	PG&E	2.07 Real time loading data for distribution operations and planning	1.75 years	1/8/2016	No	Grid Operation/Market Design; Distribution	$198,867	$1,820,000 - $2,220,000
38	2nd Triennial (2015-2017)	PG&E	2.08 “Smart” monitoring and analysis Tools	Project schedule being further evaluated - TBD	NA	No	Transmission	$0	$0

APPENDIX A
PACIFIC GAS AND ELECTRIC COMPANY
ELECTRIC PROGRAM INVESTMENT CHARGE
2013 ANNUAL REPORT

Row #	Investment Program Period	Program Administrator	Project Name	Brief description of the project - Schedule	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)
	A	B	C	E4	F	G	H	I	J
39	2nd Triennial (2015-2017)	PG&E	2.09 Distributed Series Impedance (DSI) (Phase 2)	Project schedule being further evaluated - TBD	NA	No	Transmission	$0	$0
40	2nd Triennial (2015-2017)	PG&E	2.10 Emergency preparedness modeling	2.25 years	1/8/2016	No	Transmission; Distribution	$0	$1,370,000 - $1,670,000
41	2nd Triennial (2015-2017)	PG&E	2.11 New mobile technology & visualization applications	Project schedule being further evaluated - TBD	NA	No	Distribution	$0	$0
42	2nd Triennial (2015-2017)	PG&E	2.12 New Emergency management mobile applications	Project schedule being further evaluated - TBD	NA	No	Transmission; Distribution	$0	$0
43	2nd Triennial (2015-2017)	PG&E	2.13 Digital substation/substation automation	Project schedule being further evaluated - TBD	NA	No	Transmission; Distribution	$0	$0
44	2nd Triennial (2015-2017)	PG&E	2.14 Automatically map phasing information	1.75 years	9/15/2015	No	Distribution; Demand-Side Management	$0	$1,400,000 - $1,720,000

APPENDIX A
PACIFIC GAS AND ELECTRIC COMPANY
ELECTRIC PROGRAM INVESTMENT CHARGE
2013 ANNUAL REPORT

Row #	Investment Program Period	Program Administrator	Project Name	Brief description of the project - Schedule	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)
	A	B	C	E4	F	G	H	I	J
45	2nd Triennial (2015-2017)	PG&E	2.15 Synchrophasor applications for generator dynamic model validation	2.5 years	1/8/2016	No	Transmission	$148,050	$1,090,000 - $1,340,000

Row #	Investment Program Period	Program Administrator	Project Name	Brief description of the project - Schedule	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)
	A	B	C	E4	F	G	H	I	J
46	2nd Triennial (2015-2017)	PG&E	2.16 Enhanced Synchrophasor analytics & applications	Project schedule being further evaluated - TBD	NA	No	Transmission	$0	$0
47	2nd Triennial (2015-2017)	PG&E	2.17 Geomagnetic Disturbance (GMD) evaluation	Project schedule being further evaluated - TBD	NA	No	Transmission	$0	$0
48	2nd Triennial (2015-2017)	PG&E	2.18 Optical instrument transformers and sensors for protection and control systems	Project schedule being further evaluated - TBD	NA	No	Transmission	$0	$0
49	2nd Triennial (2015-2017)	PG&E	2.19 Enable distributed demand-side strategies & technologies	2.25 years	1/8/2016	No	Distribution; Demand-Side Management	$146,000	$2,620,000 - $3,200,000
50	2nd Triennial (2015-2017)	PG&E	2.20 Real-time energy usage feedback to customers	Project schedule being further evaluated - TBD	NA	No	Grid Operations/ Market Design; Distribution; Demand-Side Management	$0	$0
51	2nd Triennial (2015-2017)	PG&E	2.21 Home Area Network (HAN) for commercial customers	1.5 years	9/15/2015	No	Demand-Side Management	$0	$180,000 - $220,000

Row #	Investment Program Period	Program Administrator	Project Name	Brief description of the project - Schedule	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)
	A	B	C	E4	F	G	H	I	J
52	2nd Triennial (2015-2017)	PG&E	2.22 Demand reduction through targeted data analytics	2.25 years	9/15/2015	No	Distribution; Demand-Side Management	$0	$1,560,000 - $1,900,000
53	2nd Triennial (2015-2017)	PG&E	2.23 Integrate demand side approaches into utility planning	2 years	1/8/2016	No	Distribution; Demand-Side Management	$1,250,085	$2,560,000 - $3,130,000
54	2nd Triennial (2015-2017)	PG&E	2.24 Appliance level bill disaggregation for non-residential customers	Project schedule being further evaluated - TBD	NA	No	Demand-Side Management	$0	$0
55	2nd Triennial (2015-2017)	PG&E	2.25 Enhanced Smart Grid Communications	Project schedule being further evaluated - TBD	NA	No	Grid Operations/ Market Design; Distribution; Demand-Side Management	$0	$0
56	2nd Triennial (2015-2017)	PG&E	2.26 Customer & distribution automation open architecture devices	2 years	9/15/2015	No	Distribution; Grid Operation/Market Design; Demand-Side Management	$0	$1,760,000 - $2,150,000
57	2nd Triennial (2015-2017)	PG&E	2.27 Next generation integrated Smart Grid network management	2 years	1/8/2016	No	Grid Operations/Market Design; Distribution; Demand-Side Management	$58,658	$1,010,000 - $1,240,000

APPENDIX A
PACIFIC GAS AND ELECTRIC COMPANY
ELECTRIC PROGRAM INVESTMENT CHARGE
2013 ANNUAL REPORT

Row #	Investment Program Period	Program Administrator	Project Name	Brief description of the project - Schedule	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Utility Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)
	A	B	C	E4	F	G	H	I	J
58	2nd Triennial (2015-2017)	PG&E	2.28 Smart Grid communications path monitoring	Project schedule being further evaluated - TBD	NA	No	Grid Operation/Market Design	$0	$0
59	2nd Triennial (2015-2017)	PG&E	2.29 Mobile meter applications	2 years	1/8/2016	No	Grid Operations/Market Design; Distribution; Demand-Side Management	$74,827	$1,730,000 - $2,120,000
60	2nd Triennial (2015-2017)	PG&E	2.30 Leverage EPIC funds to participate in industry-wide RD&D programs	Project schedule being further evaluated - TBD	NA	No	Grid Operations/ Market Design; Transmission; Distribution; Demand-Side Management	$0	$0

APPENDIX A
PACIFIC GAS AND ELECTRIC COMPANY
ELECTRIC PROGRAM INVESTMENT CHARGE
2013 ANNUAL REPORT

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to date: Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding
	A	B	C	K	L	M	N	O	P	Q
1	1st Triennial (2012-2014)	PG&E	1.01 Energy Storage for Market Operations	$709,755	$925,382	$1,635,137	All project costs are related to project activities. Admin costs are tracked separately.	Leveraged battery assets that was funded by Energy Regulators Regional Association (ERRA). Leveraged $163K, as well as software and expertise from PG&E's hydro generation group.	• Partnered with Energy Regulators Regional Association (ERRA) to leverage battery assets, software and expertise. • Partnered with California Independent System Operator (CAISO) to deploy first energy storage asset in Non-Generator Resource market and provided feedback for software improvements.	N/A
2	1st Triennial (2012-2014)	PG&E	1.02 Energy Storage for Distribution Operations	$32,316	$396,928	$429,244	All project costs are related to project activities. Admin costs are tracked separately.	N/A	N/A	N/A
3	1st Triennial (2012-2014)	PG&E	1.03 Mobile and Stationary Energy Storage Synergies	$0	$0	$0	$ -	TBD	TBD	TBD
4	1st Triennial (2012-2014)	PG&E	1.04 Expand test lab and pilot facilities for new energy storage systems. Formally Withdrawn. CPUC A.12-11-003, 10/15/2013.	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to date: Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding
	A	B	C	K	L	M	N	O	P	Q
5	1st Triennial (2012-2014)	PG&E	1.05 New Forecast Methods for Improved Storm Damage Modeling	$305,250	$119,184	$424,434	All project costs are related to project activities. Admin costs are tracked separately.	N/A	Partnered with the National Forest Service and the Geographic Area Coordination Center (GACC) to obtain feedback on fire danger model.	N/A
6	1st Triennial (2012-2014)	PG&E	1.06 Demonstrate communication systems allowing the CAISO to utilize available renewable generation flexibility	$0	$0	$0	$ -	TBD	TBD	TBD
7	1st Triennial (2012-2014)	PG&E	1.07 Demonstrate systems to ramp existing gas-fired generation more quickly to adapt to changes in variable energy resources output. Formally Withdrawn. CPUC A.12-11-003.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8	1st Triennial (2012-2014)	PG&E	1.08 Distribution System Safety and Reliability through New Data Analytics Techniques	$1,791,805	$320,835	$2,112,640	All project costs are related to project activities. Admin costs are tracked separately.	N/A	N/A	N/A
9	1st Triennial (2012-2014)	PG&E	1.09A Close proximity switching	$362,159	$133,174	$495,333	All project costs are related to project activities. Admin costs are tracked separately.	N/A	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to date: Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding
	A	B	C	K	L	M	N	O	P	Q
10	1st Triennial (2012-2014)	PG&E	1.09B and 1.10B - Network Conditioned-Based Maintenance	$71,800	$4,212	$76,012	All project costs are related to project activities. Admin costs are tracked separately.	N/A	N/A	N/A
11	1st Triennial (2012-2014)	PG&E	1.09C Discrete Reactors	$1,323,982	$674,901	$1,998,883	All project costs are related to project activities. Admin costs are tracked separately.	N/A	N/A	N/A
12	1st Triennial (2012-2014)	PG&E	1.10A Dissolved Gas Analysis	$0	$0	$0	$ -	TBD	TBD	TBD
13	1st Triennial (2012-2014)	PG&E	1.10C Underground Cable Analysis	$0	$0	$0	$ -	TBD	TBD	TBD
14	1st Triennial (2012-2014)	PG&E	1.11 Demonstrate self-correcting tools to improve system records and operations	$0	$0	$0	$ -	TBD	TBD	TBD
15	1st Triennial (2012-2014)	PG&E	1.12 Demonstrate New technologies that improve wildlife safety and protect assets from weather-related degradation	$0	$0	$0	$ -	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to date: Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding
	A	B	C	K	L	M	N	O	P	Q
16	1st Triennial (2012-2014)	PG&E	1.13 Demonstrate new communication systems to improve substation automation and interoperability	$0	$0	$0	$ -	TBD	TBD	TBD
17	1st Triennial (2012-2014)	PG&E	1.14 Next Generation SmartMeter Telecom Network Functionalities	$2,265,108	$613,919	$2,879,027	All project costs are related to project activities. Admin costs are tracked separately.	N/A	N/A	N/A
18	1st Triennial (2012-2014)	PG&E	1.15 Grid Operations Situational Intelligence	$1,341,681	$2,282,777	$3,624,458	0	N/A	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to date: Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding
	A	B	C	K	L	M	N	O	P	Q
19	1st Triennial (2012-2014)	PG&E	1.16 Vehicle-to-grid Operational Integration	$1,902,422	$1,679,581	$3,582,003	All project costs are related to project activities. Admin costs are tracked separately.	Department of Energy (DOE) provided test services using National Renewable Energy Lab (NREL) facilities. Approximate cost share to date: $120,000.	DOE/NREL; Edison Electric Institute engaged for elec. utility industry staging events; Portland General Electric closely collaborating for industry-level requirements.	N/A
20	1st Triennial (2012-2014)	PG&E	1.17 Industry participation to leverage EPIC dollars	$0	$0	$0	$ -	TBD	TBD	TBD
21	1st Triennial (2012-2014)	PG&E	1.18 Appliance-Level Load Disaggregation	$1,124,428	$66,211	$1,190,639	All project costs are related to project activities. Admin costs are tracked separately.	N/A	N/A	N/A
22	1st Triennial (2012-2014)	PG&E	1.19 Enhanced Data Techniques and Capabilities via the SmartMeter™ Platform	$704,061	$806,066	$1,510,127	All project costs are related to project activities. Admin costs are tracked separately.	Leveraging existing AMI network investments.	N/A	N/A
23	1st Triennial (2012-2014)	PG&E	1.20 Demonstrate the benefits of providing the competitive, open market with automated access to customer-authorized SmartMeter™ data to drive innovation.	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to date: Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding
	A	B	C	K	L	M	N	O	P	Q
24	1st Triennial (2012-2014)	PG&E	1.21 Automatic Identification of Distributed Photovoltaic (PV) Resources	$344,788	$331,352	$676,140	All project costs are related to project activities. Admin costs are tracked separately.	N/A	N/A	N/A
25	1st Triennial (2012-2014)	PG&E	1.22 Electric Vehicle Submetering	$639,516	$285,352	$924,868	All project costs are related to project activities. Admin costs are tracked separately.	N/A	Partnering with the following three Meter Data Management Agents (MDMAs) to assess electric vehicle service provider models: OhmConnect; eMotorWerks, and NRG.	N/A
26	1st Triennial (2012-2014)	PG&E	1.23 Photovoltaic (PV) Submetering	$369,779	$426,509	$796,288	All project costs are related to project activities. Admin costs are tracked separately.	N/A	N/A	N/A
27	1st Triennial (2012-2014)	PG&E	1.24 Demand-Side Management (DSM) for Transmission and Distribution (T&D) Cost Reduction	$1,244,844	$76,252	$1,321,096	All project costs are related to project activities. Admin costs are tracked separately.	N/A	N/A	N/A

APPENDIX A
PACIFIC GAS AND ELECTRIC COMPANY
ELECTRIC PROGRAM INVESTMENT CHARGE
2013 ANNUAL REPORT

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to date: Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding
	A	B	C	K	L	M	N	O	P	Q
28	1st Triennial (2012-2014)	PG&E	1.25 Direct Current (DC) Fast Charging Mapping	$232,772	$103,823	$336,595	All project costs are related to project activities. Admin costs are tracked separately.	N/A	N/A	N/A
29	1st Triennial (2012-2014)	PG&E	1.26 Pilot measurement and telemetry strategies and technologies that enable the cost-effective integration of mass market Demand Response (DR) resources into the CAISO wholesale market	$0	$0	$0	$ -	TBD	TBD	TBD
30	2nd Triennial (2015-2017)	PG&E	2.01 Evaluate storage on the distribution grid	$0	$0	$0	$ -	TBD	TBD	TBD
31	2nd Triennial (2015-2017)	PG&E	2.02 Pilot Distributed Energy Management Systems (DERMS)	$475,445	$58	$475,503	0	N/A	N/A	N/A

APPENDIX A
PACIFIC GAS AND ELECTRIC COMPANY
ELECTRIC PROGRAM INVESTMENT CHARGE
2013 ANNUAL REPORT

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to date: Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding
	A	B	C	K	L	M	N	O	P	Q
32	2nd Triennial (2015-2017)	PG&E	2.03A Test Smart Inverter Enhanced Capabilities - Photovoltaics (PV)	$24,283	$2,992	$27,275	$1,140	This project is leveraging funds from the PG&E Smart Grid Volt/Var Optimization (VVO) pilot given they are completing the testing of the functionality of the smart inverter technologies. The results of the testing will impact this project's opportunity to launch.	PG&E Smart Grid VVO Pilot	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to date: Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding
	A	B	C	K	L	M	N	O	P	Q
33	2nd Triennial (2015-2017)	PG&E	2.03B Test Smart Inverter Enhanced Capabilities - Electric Vehicle (EV)	$0	$0	$0	0	TBD	TBD	TBD
34	2nd Triennial (2015-2017)	PG&E	2.04 DG monitoring & voltage tracking	$77,757	$17,269	$95,026	$ 1,217	TBD	TBD	TBD
35	2nd Triennial (2015-2017)	PG&E	2.05 Inertia response emulation for DG impact improvement	$0	$0	$0	$ -	TBD	TBD	TBD
36	2nd Triennial (2015-2017)	PG&E	2.06 Intelligent Universal Transformer (IUT)	$0	$0	$0	0	TBD	TBD	TBD
37	2nd Triennial (2015-2017)	PG&E	2.07 Real time loading data for distribution operations and planning	$107,652	$31,177	$138,829	$ 536	TBD	TBD	TBD
38	2nd Triennial (2015-2017)	PG&E	2.08 “Smart” monitoring and analysis Tools	$0	$0	$0	$ -	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to date: Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding
	A	B	C	K	L	M	N	O	P	Q
39	2nd Triennial (2015-2017)	PG&E	2.09 Distributed Series Impedance (DSI) (Phase 2)	$0	$0	$0	$ -	TBD	TBD	TBD
40	2nd Triennial (2015-2017)	PG&E	2.10 Emergency preparedness modeling	$0	$25	$25	$ 25	TBD	TBD	TBD
41	2nd Triennial (2015-2017)	PG&E	2.11 New mobile technology & visualization applications	$0	$0	$0	$ -	TBD	TBD	TBD
42	2nd Triennial (2015-2017)	PG&E	2.12 New Emergency management mobile applications	$0	$0	$0	$ -	TBD	TBD	TBD
43	2nd Triennial (2015-2017)	PG&E	2.13 Digital substation/substation automation	$0	$0	$0	$ -	TBD	TBD	TBD
44	2nd Triennial (2015-2017)	PG&E	2.14 Automatically map phasing information	$0	$0	$0	$ -	TBD	TBD	TBD

APPENDIX A
PACIFIC GAS AND ELECTRIC COMPANY
ELECTRIC PROGRAM INVESTMENT CHARGE
2013 ANNUAL REPORT

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to date: Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding
	A	B	C	K	L	M	N	O	P	Q
45	2nd Triennial (2015-2017)	PG&E	2.15 Synchrophasor applications for generator dynamic model validation	$82,050	$8,305	$90,355	$ -	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to date: Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding
	A	B	C	K	L	M	N	O	P	Q
46	2nd Triennial (2015-2017)	PG&E	2.16 Enhanced Synchrophasor analytics & applications	$0	$0	$0	$ -	TBD	TBD	TBD
47	2nd Triennial (2015-2017)	PG&E	2.17 Geomagnetic Disturbance (GMD) evaluation	$0	$0	$0	$ -	TBD	TBD	TBD
48	2nd Triennial (2015-2017)	PG&E	2.18 Optical instrument transformers and sensors for protection and control systems	$0	$0	$0	$ -	TBD	TBD	TBD
49	2nd Triennial (2015-2017)	PG&E	2.19 Enable distributed demand-side strategies & technologies	$30,747	$24,507	$55,253	$ 1,710	TBD	TBD	TBD
50	2nd Triennial (2015-2017)	PG&E	2.20 Real-time energy usage feedback to customers	$0	$0	$0	$ -	TBD	TBD	TBD
51	2nd Triennial (2015-2017)	PG&E	2.21 Home Area Network (HAN) for commercial customers	$0	$0	$0	$ -	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to date: Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding
	A	B	C	K	L	M	N	O	P	Q
52	2nd Triennial (2015-2017)	PG&E	2.22 Demand reduction through targeted data analytics	$0	$0	$0	$ -	TBD	TBD	TBD
53	2nd Triennial (2015-2017)	PG&E	2.23 Integrate demand side approaches into utility planning	$452,176	$99,045	$551,221	$ 799	TBD	TBD	TBD
54	2nd Triennial (2015-2017)	PG&E	2.24 Appliance level bill disaggregation for non-residential customers	$0	$0	$0	$ -	TBD	TBD	TBD
55	2nd Triennial (2015-2017)	PG&E	2.25 Enhanced Smart Grid Communications	$0	$0	$0	$ -	TBD	TBD	TBD
56	2nd Triennial (2015-2017)	PG&E	2.26 Customer & distribution automation open architecture devices	$0	$265	$265	$ -	TBD	TBD	TBD
57	2nd Triennial (2015-2017)	PG&E	2.27 Next generation integrated Smart Grid network management	$33,940	$32,766	$66,706	$ -	TBD	TBD	TBD

APPENDIX A
PACIFIC GAS AND ELECTRIC COMPANY
ELECTRIC PROGRAM INVESTMENT CHARGE
2013 ANNUAL REPORT

Row #	Investment Program Period	Program Administrator	Project Name	Funds Expended to date: Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding
	A	B	C	K	L	M	N	O	P	Q
58	2nd Triennial (2015-2017)	PG&E	2.28 Smart Grid communications path monitoring	$0	$0	$0	$ -	TBD	TBD	TBD
59	2nd Triennial (2015-2017)	PG&E	2.29 Mobile meter applications	$166,593	$94,563	$261,155	$ -	TBD	TBD	TBD
60	2nd Triennial (2015-2017)	PG&E	2.30 Leverage EPIC funds to participate in industry-wide RD&D programs	$0	$0	$0	$ -	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards.	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder.
	A	B	C	R	S	T	U	V	W
1	1st Triennial (2012-2014)	PG&E	1.01 Energy Storage for Market Operations	N/A	Pay for performance	N/A - No current evidence of IP development	Direct Award: •Power Settlements Consulting (sole vendor that could provide solution without modification or required hardware) • Trimark Associates (enhancements were made to their equipment for this EPIC project, as they were the original vendor under the capital project for the Yerba Buena and Vaca batteries)	N/A	N/A
2	1st Triennial (2012-2014)	PG&E	1.02 Energy Storage for Distribution Operations	N/A	Pay for Performance	N/A - No current evidence of IP development	Competitive Bid	11	Cupertino Electric
3	1st Triennial (2012-2014)	PG&E	1.03 Mobile and Stationary Energy Storage Synergies	TBD	TBD	TBD	TBD	TBD	TBD
4	1st Triennial (2012-2014)	PG&E	1.04 Expand test lab and pilot facilities for new energy storage systems. Formally Withdrawn. CPUC A.12-11-003, 10/15/2013.	N/A	N/A	N/A	N/A	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards.	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder.
	A	B	C	R	S	T	U	V	W
5	1st Triennial (2012-2014)	PG&E	1.05 New Forecast Methods for Improved Storm Damage Modeling	N/A	Pay for performance	N/A - No current evidence of IP development	Competitive Bid	• 1st award: 6 • 2nd award: 6	• 1st award: Weather Decision Technologies • 2nd award: Vertum Partners
6	1st Triennial (2012-2014)	PG&E	1.06 Demonstrate communication systems allowing the CAISO to utilize available renewable generation flexibility	TBD	TBD	TBD	TBD	TBD	TBD
7	1st Triennial (2012-2014)	PG&E	1.07 Demonstrate systems to ramp existing gas-fired generation more quickly to adapt to changes in variable energy resources output. Formally Withdrawn. CPUC A.12-11-003.	N/A	N/A	N/A	N/A	N/A	N/A
8	1st Triennial (2012-2014)	PG&E	1.08 Distribution System Safety and Reliability through New Data Analytics Techniques	N/A	Pay for performance	N/A - No current evidence of IP development	Competitive Bid	7	Space Time Insight
9	1st Triennial (2012-2014)	PG&E	1.09A Close proximity switching	N/A	Pay for Performance	TBD	Competitive Bid	4	Two vendors chosen from RFP: • Inertia Switch • Trayer Also, Direct Award for Remote Solutions - did not respond to RFP, but shortly after competitive bid process completed they announced independent creation of similar product.

Row #	Investment Program Period	Program Administrator	Project Name	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards.	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder.
	A	B	C	R	S	T	U	V	W
10	1st Triennial (2012-2014)	PG&E	1.09B and 1.10B - Network Conditioned-Based Maintenance	N/A	Pay for performance	N/A - No current evidence of IP development	Competitive Bid	Phase I: 5 bids Phase 2: 4 bids	Phase 1: Black and Veatch Phase 2: Exponent
11	1st Triennial (2012-2014)	PG&E	1.09C Discrete Reactors	N/A	Pay for Performance	N/A - No current evidence of IP development	Direct Award - Smart Wires, Inc. They are the developer and sole supplier of DSR devices.	N/A	N/A
12	1st Triennial (2012-2014)	PG&E	1.10A Dissolved Gas Analysis	TBD	TBD	TBD	TBD	TBD	TBD
13	1st Triennial (2012-2014)	PG&E	1.10C Underground Cable Analysis	TBD	TBD	TBD	TBD	TBD	TBD
14	1st Triennial (2012-2014)	PG&E	1.11 Demonstrate self-correcting tools to improve system records and operations	TBD	TBD	TBD	TBD	TBD	TBD
15	1st Triennial (2012-2014)	PG&E	1.12 Demonstrate New technologies that improve wildlife safety and protect assets from weather-related degradation	TBD	TBD	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards.	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder.
	A	B	C	R	S	T	U	V	W
16	1st Triennial (2012-2014)	PG&E	1.13 Demonstrate new communication systems to improve substation automation and interoperability	TBD	TBD	TBD	TBD	TBD	TBD
17	1st Triennial (2012-2014)	PG&E	1.14 Next Generation SmartMeter Telecom Network Functionalities	N/A	Pay for Performance	TBD - Smart Pole Meter and Meter Socket	Direct Award - Silver Springs Network SSN is the solutions provider for PG&E's AMI electric network. We must work with SSN to ensure that devices and applications can communicate across the AMI network.	N/A	N/A
18	1st Triennial (2012-2014)	PG&E	1.15 Grid Operations Situational Intelligence	N/A	Pay For Performance	New intellectual property has been created through co-development with the vendor. PG&E retains ownership rights to the IP and will provide free unlimited use rights to CA IOUs per the CPUC decision.	Competitive Bid	3	BitStew

Row #	Investment Program Period	Program Administrator	Project Name	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards.	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder.
	A	B	C	R	S	T	U	V	W
19	1st Triennial (2012-2014)	PG&E	1.16 Vehicle-to-grid Operational Integration	N/A	Pay for performance	N/A - No current evidence of IP development	Phase 1: Direct Award - Efficient Drivetrains, Inc. and Electric Vehicles International - Short-term availability of prototype driveline - Capable of generating utility-grade export power on F550 - diesel/gasoline configuration Phase 2: Competitive Bid	Phase 1: N/A Phase 2: 1	Phase 1: N/A Phase 2: Efficient Drivetrains, Inc. (EDI) - Released RFP, but only one (EDI) passed the initial round.
20	1st Triennial (2012-2014)	PG&E	1.17 Industry participation to leverage EPIC dollars	TBD	TBD	TBD	TBD	TBD	TBD
21	1st Triennial (2012-2014)	PG&E	1.18 Appliance-Level Load Disaggregation	N/A	Pay for performance	N/A - No current evidence of IP development	Direct Award - Silver Springs Network SSN is the solutions provider for PG&E's AMI electric network. We must work with SSN to ensure that devices and applications can communicate across the AMI network.	N/A	N/A
22	1st Triennial (2012-2014)	PG&E	1.19 Enhanced Data Techniques and Capabilities via the SmartMeter™ Platform	N/A	Pay for Performance	TBD	Competitive Bid for energy diversion detection use case only.	3	BitStew & Primestone
23	1st Triennial (2012-2014)	PG&E	1.20 Demonstrate the benefits of providing the competitive, open market with automated access to customer-authorized SmartMeter™ data to drive innovation.	N/A	N/A	N/A - No current evidence of IP development	N/A	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards.	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder.
	A	B	C	R	S	T	U	V	W
24	1st Triennial (2012-2014)	PG&E	1.21 Automatic Identification of Distributed Photovoltaic (PV) Resources	N/A	Pay for performance	TBD	Direct Award - Nexant. Vendor selected due to expertise in PG&E's CC&B database, PV generation data analysis and AMI network.	N/A	N/A
25	1st Triennial (2012-2014)	PG&E	1.22 Electric Vehicle Submetering	N/A	N/A	TBD	Competitive Bid	3	Nexant, Inc.
26	1st Triennial (2012-2014)	PG&E	1.23 Photovoltaic (PV) Submetering	N/A	Pay for performance	N/A - No current evidence of IP development	Direct Award - • Opower - PG&E's customer facing web portal, My Energy. Given the project is integrated PV generation interval data into My Energy, it was necessary to work with them. • Clean Power Research - Purchased subscription to estimated generation data.	N/A	N/A
27	1st Triennial (2012-2014)	PG&E	1.24 Demand-Side Management (DSM) for Transmission and Distribution (T&D) Cost Reduction	N/A	Pay for performance	N/A - No current evidence of IP development	Direct Award - Enetics A consulting firm performed a study that assessed the available technologies that would best address the need of the project and determined Enetics provides that solution. They were also willing to make enhancements to their device to further meet the need of PG&E and were the lowest cost and immediately available.	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards.	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder.
	A	B	C	R	S	T	U	V	W
28	1st Triennial (2012-2014)	PG&E	1.25 Direct Current (DC) Fast Charging Mapping	N/A	Pay for Performance	TBD	Competitive Bid	4	Energy and Environmental Economics, Inc. (E3)
29	1st Triennial (2012-2014)	PG&E	1.26 Pilot measurement and telemetry strategies and technologies that enable the cost-effective integration of mass market Demand Response (DR) resources into the CAISO wholesale market	TBD	TBD	TBD	TBD	TBD	TBD
30	2nd Triennial (2015-2017)	PG&E	2.01 Evaluate storage on the distribution grid	TBD	TBD	TBD	TBD	TBD	TBD
31	2nd Triennial (2015-2017)	PG&E	2.02 Pilot Distributed Energy Management Systems (DERMS)	N/A	Pay for performance	TBD	Competitive Bid	5	RFP vendor selection completed in 2015, but contract to be signed in 2016. PG&E will disclose vendor identify within 90 days of contract execution.

Row #	Investment Program Period	Program Administrator	Project Name	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards.	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder.
	A	B	C	R	S	T	U	V	W
32	2nd Triennial (2015-2017)	PG&E	2.03A Test Smart Inverter Enhanced Capabilities - Photovoltaics (PV)	TBD	Pay for Performance	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards.	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder.
	A	B	C	R	S	T	U	V	W
33	2nd Triennial (2015-2017)	PG&E	2.03B Test Smart Inverter Enhanced Capabilities - Electric Vehicle (EV)	TBD	Pay for Performance	TBD	TBD	TBD	TBD
34	2nd Triennial (2015-2017)	PG&E	2.04 DG monitoring & voltage tracking	TBD	TBD	TBD	TBD	TBD	TBD
35	2nd Triennial (2015-2017)	PG&E	2.05 Inertia response emulation for DG impact improvement	TBD	TBD	TBD	TBD	TBD	TBD
36	2nd Triennial (2015-2017)	PG&E	2.06 Intelligent Universal Transformer (IUT)	TBD	TBD	TBD	TBD	TBD	TBD
37	2nd Triennial (2015-2017)	PG&E	2.07 Real time loading data for distribution operations and planning	TBD	TBD	TBD	TBD	TBD	TBD
38	2nd Triennial (2015-2017)	PG&E	2.08 “Smart” monitoring and analysis Tools	TBD	TBD	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards.	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder.
	A	B	C	R	S	T	U	V	W
39	2nd Triennial (2015-2017)	PG&E	2.09 Distributed Series Impedance (DSI) (Phase 2)	TBD	TBD	TBD	TBD	TBD	TBD
40	2nd Triennial (2015-2017)	PG&E	2.10 Emergency preparedness modeling	TBD	TBD	TBD	TBD	TBD	TBD
41	2nd Triennial (2015-2017)	PG&E	2.11 New mobile technology & visualization applications	TBD	TBD	TBD	TBD	TBD	TBD
42	2nd Triennial (2015-2017)	PG&E	2.12 New Emergency management mobile applications	TBD	TBD	TBD	TBD	TBD	TBD
43	2nd Triennial (2015-2017)	PG&E	2.13 Digital substation/substation automation	TBD	TBD	TBD	TBD	TBD	TBD
44	2nd Triennial (2015-2017)	PG&E	2.14 Automatically map phasing information	TBD	TBD	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards.	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder.
	A	B	C	R	S	T	U	V	W
45	2nd Triennial (2015-2017)	PG&E	2.15 Synchrophasor applications for generator dynamic model validation	TBD	TBD	TBD	Direct Award - MatLab is a widely-used analysis software package.	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards.	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder.
	A	B	C	R	S	T	U	V	W
46	2nd Triennial (2015-2017)	PG&E	2.16 Enhanced Synchrophasor analytics & applications	TBD	TBD	TBD	TBD	TBD	TBD
47	2nd Triennial (2015-2017)	PG&E	2.17 Geomagnetic Disturbance (GMD) evaluation	TBD	TBD	TBD	TBD	TBD	TBD
48	2nd Triennial (2015-2017)	PG&E	2.18 Optical instrument transformers and sensors for protection and control systems	TBD	TBD	TBD	TBD	TBD	TBD
49	2nd Triennial (2015-2017)	PG&E	2.19 Enable distributed demand-side strategies & technologies	TBD	TBD	TBD	TBD	TBD	TBD
50	2nd Triennial (2015-2017)	PG&E	2.20 Real-time energy usage feedback to customers	TBD	TBD	TBD	TBD	TBD	TBD
51	2nd Triennial (2015-2017)	PG&E	2.21 Home Area Network (HAN) for commercial customers	TBD	TBD	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards.	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder.
	A	B	C	R	S	T	U	V	W
52	2nd Triennial (2015-2017)	PG&E	2.22 Demand reduction through targeted data analytics	TBD	TBD	TBD	TBD	TBD	TBD
53	2nd Triennial (2015-2017)	PG&E	2.23 Integrate demand side approaches into utility planning	TBD	Pay for Performance	N/A - No current evidence of IP development	Direct Award - Integral Analytics (IA) IA was issued a direct award given they are the developer/vendor for LoadSEER, which is the tool that is being modified to achieve the goals of this project.	N/A	N/A
54	2nd Triennial (2015-2017)	PG&E	2.24 Appliance level bill disaggregation for non-residential customers	TBD	TBD	TBD	TBD	TBD	TBD
55	2nd Triennial (2015-2017)	PG&E	2.25 Enhanced Smart Grid Communications	TBD	TBD	TBD	TBD	TBD	TBD
56	2nd Triennial (2015-2017)	PG&E	2.26 Customer & distribution automation open architecture devices	TBD	TBD	TBD	TBD	TBD	TBD
57	2nd Triennial (2015-2017)	PG&E	2.27 Next generation integrated Smart Grid network management	TBD	TBD	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards.	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder.
	A	B	C	R	S	T	U	V	W
58	2nd Triennial (2015-2017)	PG&E	2.28 Smart Grid communications path monitoring	TBD	TBD	TBD	TBD	TBD	TBD
59	2nd Triennial (2015-2017)	PG&E	2.29 Mobile meter applications	TBD	TBD	TBD	TBD	TBD	TBD
60	2nd Triennial (2015-2017)	PG&E	2.30 Leverage EPIC funds to participate in industry-wide RD&D programs	TBD	TBD	TBD	TBD	TBD	TBD

Row #	Investment Program Period	Program Administrator	Project Name	If competitively selected, provide the rank of the selected bidder in the selection process.	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected.	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization.	Does award recipient identify as California-based entity, small business, businesses owned by women, minorities, or disabled veterans? Information requested for technology vendor procurements only (i.e. not PMs, Consulting services, etc.)	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals
	A	B	C	X	Y	Z	AA	AB
1	1st Triennial (2012-2014)	PG&E	1.01 Energy Storage for Market Operations	N/A	N/A	Column applicable to CEC only	Yes. •Power Settlements Consulting - California-based • Trimark Associates - California-based	Column applicable to CEC only
2	1st Triennial (2012-2014)	PG&E	1.02 Energy Storage for Distribution Operations	1	N/A	Column applicable to CEC only	Yes - California-based.	Column applicable to CEC only
3	1st Triennial (2012-2014)	PG&E	1.03 Mobile and Stationary Energy Storage Synergies	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
4	1st Triennial (2012-2014)	PG&E	1.04 Expand test lab and pilot facilities for new energy storage systems. Formally Withdrawn. CPUC A.12-11-003, 10/15/2013.	N/A	N/A	Column applicable to CEC only	N/A	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	If competitively selected, provide the rank of the selected bidder in the selection process.	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected.	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization.	Does award recipient identify as California-based entity, small business, businesses owned by women, minorities, or disabled veterans? Information requested for technology vendor procurements only (i.e. not PMs, Consulting services, etc.)	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals
	A	B	C	X	Y	Z	AA	AB
5	1st Triennial (2012-2014)	PG&E	1.05 New Forecast Methods for Improved Storm Damage Modeling	• 1st award: 1 • 2nd award: 1	N/A	N/A	• Weather Decision Technologies: No • Vertum Partners: Yes - California-based	Column applicable to CEC only
6	1st Triennial (2012-2014)	PG&E	1.06 Demonstrate communication systems allowing the CAISO to utilize available renewable generation flexibility	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
7	1st Triennial (2012-2014)	PG&E	1.07 Demonstrate systems to ramp existing gas-fired generation more quickly to adapt to changes in variable energy resources output. Formally Withdrawn. CPUC A.12-11-003.	N/A	N/A	Column applicable to CEC only	N/A	Column applicable to CEC only
8	1st Triennial (2012-2014)	PG&E	1.08 Distribution System Safety and Reliability through New Data Analytics Techniques	1	N/A	Column applicable to CEC only	Yes - California-based	Column applicable to CEC only
9	1st Triennial (2012-2014)	PG&E	1.09A Close proximity switching	The two RFP vendors tied for first.	N/A	Column applicable to CEC only	No	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	If competitively selected, provide the rank of the selected bidder in the selection process.	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected.	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization.	Does award recipient identify as California-based entity, small business, businesses owned by women, minorities, or disabled veterans? Information requested for technology vendor procurements only (i.e. not PMs, Consulting services, etc.)	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals
	A	B	C	X	Y	Z	AA	AB
10	1st Triennial (2012-2014)	PG&E	1.09B and 1.10B - Network Conditioned-Based Maintenance	Phase 1: 1 Phase 2: 1	N/A	Column applicable to CEC only	No	Column applicable to CEC only
11	1st Triennial (2012-2014)	PG&E	1.09C Discrete Reactors	N/A	N/A	Column applicable to CEC only	No	Column applicable to CEC only
12	1st Triennial (2012-2014)	PG&E	1.10A Dissolved Gas Analysis	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
13	1st Triennial (2012-2014)	PG&E	1.10C Underground Cable Analysis	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
14	1st Triennial (2012-2014)	PG&E	1.11 Demonstrate self-correcting tools to improve system records and operations	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
15	1st Triennial (2012-2014)	PG&E	1.12 Demonstrate New technologies that improve wildlife safety and protect assets from weather-related degradation	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	If competitively selected, provide the rank of the selected bidder in the selection process.	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected.	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization.	Does award recipient identify as California-based entity, small business, businesses owned by women, minorities, or disabled veterans? Information requested for technology vendor procurements only (i.e. not PMs, Consulting services, etc.)	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals
	A	B	C	X	Y	Z	AA	AB
16	1st Triennial (2012-2014)	PG&E	1.13 Demonstrate new communication systems to improve substation automation and interoperability	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
17	1st Triennial (2012-2014)	PG&E	1.14 Next Generation SmartMeter Telecom Network Functionalities	N/A	N/A	Column applicable to CEC only	No	Column applicable to CEC only
18	1st Triennial (2012-2014)	PG&E	1.15 Grid Operations Situational Intelligence	1	N/A	Column applicable to CEC only	No	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	If competitively selected, provide the rank of the selected bidder in the selection process.	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected.	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization.	Does award recipient identify as California-based entity, small business, businesses owned by women, minorities, or disabled veterans? Information requested for technology vendor procurements only (i.e. not PMs, Consulting services, etc.)	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals
	A	B	C	X	Y	Z	AA	AB
19	1st Triennial (2012-2014)	PG&E	1.16 Vehicle-to-grid Operational Integration	Phase 1: N/A Phase 2: 1	N/A	Column applicable to CEC only	No	Column applicable to CEC only
20	1st Triennial (2012-2014)	PG&E	1.17 Industry participation to leverage EPIC dollars	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
21	1st Triennial (2012-2014)	PG&E	1.18 Appliance-Level Load Disaggregation	N/A	N/A	Column applicable to CEC only	No	Column applicable to CEC only
22	1st Triennial (2012-2014)	PG&E	1.19 Enhanced Data Techniques and Capabilities via the SmartMeter™ Platform	Tie for first	N/A	Column applicable to CEC only	No	Column applicable to CEC only
23	1st Triennial (2012-2014)	PG&E	1.20 Demonstrate the benefits of providing the competitive, open market with automated access to customer-authorized SmartMeter™ data to drive innovation.	N/A	N/A	N/A	N/A	N/A

Row #	Investment Program Period	Program Administrator	Project Name	If competitively selected, provide the rank of the selected bidder in the selection process.	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected.	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization.	Does award recipient identify as California-based entity, small business, businesses owned by women, minorities, or disabled veterans? Information requested for technology vendor procurements only (i.e. not PMs, Consulting services, etc.)	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals
	A	B	C	X	Y	Z	AA	AB
24	1st Triennial (2012-2014)	PG&E	1.21 Automatic Identification of Distributed Photovoltaic (PV) Resources	N/A	N/A	Column applicable to CEC only	No	Column applicable to CEC only
25	1st Triennial (2012-2014)	PG&E	1.22 Electric Vehicle Submetering	1	N/A	Column applicable to CEC only	No	Column applicable to CEC only
26	1st Triennial (2012-2014)	PG&E	1.23 Photovoltaic (PV) Submetering	N/A	N/A	Column applicable to CEC only	Opower - No Clean Power Research - Yes: California-based	Column applicable to CEC only
27	1st Triennial (2012-2014)	PG&E	1.24 Demand-Side Management (DSM) for Transmission and Distribution (T&D) Cost Reduction	N/A	N/A	Column applicable to CEC only	No	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	If competitively selected, provide the rank of the selected bidder in the selection process.	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected.	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization.	Does award recipient identify as California-based entity, small business, businesses owned by women, minorities, or disabled veterans? Information requested for technology vendor procurements only (i.e. not PMs, Consulting services, etc.)	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals
	A	B	C	X	Y	Z	AA	AB
28	1st Triennial (2012-2014)	PG&E	1.25 Direct Current (DC) Fast Charging Mapping	1	N/A	N/A	Yes - California-based, small business, and Minority Based Enterprise (MBE).	Column applicable to CEC only
29	1st Triennial (2012-2014)	PG&E	1.26 Pilot measurement and telemetry strategies and technologies that enable the cost-effective integration of mass market Demand Response (DR) resources into the CAISO wholesale market	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
30	2nd Triennial (2015-2017)	PG&E	2.01 Evaluate storage on the distribution grid	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
31	2nd Triennial (2015-2017)	PG&E	2.02 Pilot Distributed Energy Management Systems (DERMS)	1	N/A	Column applicable to CEC only	No	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	If competitively selected, provide the rank of the selected bidder in the selection process.	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected.	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization.	Does award recipient identify as California-based entity, small business, businesses owned by women, minorities, or disabled veterans? Information requested for technology vendor procurements only (i.e. not PMs, Consulting services, etc.)	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals
	A	B	C	X	Y	Z	AA	AB
32	2nd Triennial (2015-2017)	PG&E	2.03A Test Smart Inverter Enhanced Capabilities - Photovoltaics (PV)	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	If competitively selected, provide the rank of the selected bidder in the selection process.	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected.	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization.	Does award recipient identify as California-based entity, small business, businesses owned by women, minorities, or disabled veterans? Information requested for technology vendor procurements only (i.e. not PMs, Consulting services, etc.)	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals
	A	B	C	X	Y	Z	AA	AB
33	2nd Triennial (2015-2017)	PG&E	2.03B Test Smart Inverter Enhanced Capabilities - Electric Vehicle (EV)	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
34	2nd Triennial (2015-2017)	PG&E	2.04 DG monitoring & voltage tracking	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
35	2nd Triennial (2015-2017)	PG&E	2.05 Inertia response emulation for DG impact improvement	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
36	2nd Triennial (2015-2017)	PG&E	2.06 Intelligent Universal Transformer (IUT)	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
37	2nd Triennial (2015-2017)	PG&E	2.07 Real time loading data for distribution operations and planning	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
38	2nd Triennial (2015-2017)	PG&E	2.08 “Smart” monitoring and analysis Tools	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	If competitively selected, provide the rank of the selected bidder in the selection process.	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected.	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization.	Does award recipient identify as California-based entity, small business, businesses owned by women, minorities, or disabled veterans? Information requested for technology vendor procurements only (i.e. not PMs, Consulting services, etc.)	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals
	A	B	C	X	Y	Z	AA	AB
39	2nd Triennial (2015-2017)	PG&E	2.09 Distributed Series Impedance (DSI) (Phase 2)	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
40	2nd Triennial (2015-2017)	PG&E	2.10 Emergency preparedness modeling	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
41	2nd Triennial (2015-2017)	PG&E	2.11 New mobile technology & visualization applications	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
42	2nd Triennial (2015-2017)	PG&E	2.12 New Emergency management mobile applications	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
43	2nd Triennial (2015-2017)	PG&E	2.13 Digital substation/substation automation	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
44	2nd Triennial (2015-2017)	PG&E	2.14 Automatically map phasing information	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	If competitively selected, provide the rank of the selected bidder in the selection process.	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected.	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization.	Does award recipient identify as California-based entity, small business, businesses owned by women, minorities, or disabled veterans? Information requested for technology vendor procurements only (i.e. not PMs, Consulting services, etc.)	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals
	A	B	C	X	Y	Z	AA	AB
45	2nd Triennial (2015-2017)	PG&E	2.15 Synchrophasor applications for generator dynamic model validation	N/A	N/A	Column applicable to CEC only	No	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	If competitively selected, provide the rank of the selected bidder in the selection process.	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected.	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization.	Does award recipient identify as California-based entity, small business, businesses owned by women, minorities, or disabled veterans? Information requested for technology vendor procurements only (i.e. not PMs, Consulting services, etc.)	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals
	A	B	C	X	Y	Z	AA	AB
46	2nd Triennial (2015-2017)	PG&E	2.16 Enhanced Synchrophasor analytics & applications	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
47	2nd Triennial (2015-2017)	PG&E	2.17 Geomagnetic Disturbance (GMD) evaluation	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
48	2nd Triennial (2015-2017)	PG&E	2.18 Optical instrument transformers and sensors for protection and control systems	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
49	2nd Triennial (2015-2017)	PG&E	2.19 Enable distributed demand-side strategies & technologies	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
50	2nd Triennial (2015-2017)	PG&E	2.20 Real-time energy usage feedback to customers	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
51	2nd Triennial (2015-2017)	PG&E	2.21 Home Area Network (HAN) for commercial customers	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	If competitively selected, provide the rank of the selected bidder in the selection process.	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected.	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization.	Does award recipient identify as California-based entity, small business, businesses owned by women, minorities, or disabled veterans? Information requested for technology vendor procurements only (i.e. not PMs, Consulting services, etc.)	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals
	A	B	C	X	Y	Z	AA	AB
52	2nd Triennial (2015-2017)	PG&E	2.22 Demand reduction through targeted data analytics	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
53	2nd Triennial (2015-2017)	PG&E	2.23 Integrate demand side approaches into utility planning	N/A	N/A	Column applicable to CEC only	No	Column applicable to CEC only
54	2nd Triennial (2015-2017)	PG&E	2.24 Appliance level bill disaggregation for non-residential customers	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
55	2nd Triennial (2015-2017)	PG&E	2.25 Enhanced Smart Grid Communications	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
56	2nd Triennial (2015-2017)	PG&E	2.26 Customer & distribution automation open architecture devices	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
57	2nd Triennial (2015-2017)	PG&E	2.27 Next generation integrated Smart Grid network management	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only

Row #	Investment Program Period	Program Administrator	Project Name	If competitively selected, provide the rank of the selected bidder in the selection process.	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected.	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization.	Does award recipient identify as California-based entity, small business, businesses owned by women, minorities, or disabled veterans? Information requested for technology vendor procurements only (i.e. not PMs, Consulting services, etc.)	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals
	A	B	C	X	Y	Z	AA	AB
58	2nd Triennial (2015-2017)	PG&E	2.28 Smart Grid communications path monitoring	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
59	2nd Triennial (2015-2017)	PG&E	2.29 Mobile meter applications	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only
60	2nd Triennial (2015-2017)	PG&E	2.30 Leverage EPIC funds to participate in industry-wide RD&D programs	TBD	TBD	Column applicable to CEC only	TBD	Column applicable to CEC only

APPENDIX A
PACIFIC GAS AND ELECTRIC COMPANY
ELECTRIC PROGRAM INVESTMENT CHARGE
2013 ANNUAL REPORT

Row #	Investment Program Period	Program Administrator	Project Name	Applicable metrics	Update
	A	B	C	AC	AD
1	1st Triennial (2012-2014)	PG&E	1.01 Energy Storage for Market Operations	3a - Maintain/Reduce operations and maintenance costs. 7b - Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (PU Code § 8360); 7h - Deployment and integration of cost-effective advanced electricity storage and peak-shaving technologies, including plug-in electric and hybrid electric vehicles, and thermal-storage air conditioning (PU Code § 8360) 9c - EPIC project results referenced in regulatory proceedings and policy reports (Business Plan references: CPUC Rulemaking 10-12-007) - this project would provide data to understand the cost-effectiveness of battery storage.	• Project is in Build/Test phase. • Deployed and demonstrated primary technological goal of this project - PG&E Vaca Dixon Battery Energy Storage Systems followed CAISO market awards automatically. • Next steps are to execute automatic bidding into CAISO market with PG&E's Battery Energy Storage System at Yerba Buena, and continue bidding the Vaca Dixon battery resource into CAISO markets up to project closeout.
2	1st Triennial (2012-2014)	PG&E	1.02 Energy Storage for Distribution Operations	1c - Avoided procurement and generation costs. 7b - Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (PU Code § 8360); 7d - Deployment and integration of cost-effective distributed resources and generation, including renewable resources (PU Code § 8360). 9c - EPIC project results referenced in regulatory proceedings and policy reports (Business Plan references: Deferring a capacity upgrade has been identified as a key potential value of energy storage technologies (ESTs) and noted in filings with the CPUC / AB 2514.	• Project is in Design/Engineering Phase. • Identified project site, developed and successfully administered a Request for Proposal (RFP) for project Engineering, Procurement and Construction (EPC) services, signed an EPC contract for 500kW/4 hour lithium-ion battery installation, and initiated electrical and civil design work. • Next steps are to finalize designs, mobilize site, and prove use case.
3	1st Triennial (2012-2014)	PG&E	1.03 Mobile and Stationary Energy Storage Synergies	TBD	Project is currently on-hold.
4	1st Triennial (2012-2014)	PG&E	1.04 Expand test lab and pilot facilities for new energy storage systems. Formally Withdrawn. CPUC A.12-11-003, 10/15/2013.	N/A	Formally Withdrawn

Row #	Investment Program Period	Program Administrator	Project Name	Applicable metrics	Update
	A	B	C	AC	AD
5	1st Triennial (2012-2014)	PG&E	1.05 New Forecast Methods for Improved Storm Damage Modeling	3a - Maintain/Reduce operations and maintenance costs. 4a - GHG emissions reductions (MMTCO2e) 5c - Forecast accuracy improvement 5e - Utility worker safety improvement and hazard exposure reduction	• Three use cases are in different Phases: Use Case 1 (Improved Damage Modeling) is in Staging Phase; Use Case 2 (Improved Fire Weather Awareness) is in Build/Test Phase. Use Case 3 (Solar Irradiance Data Use) is in Design/Engineering Phase. • Detailed weather forecast data from POMMS improved storm damage modeling in Electric Operations, improving storm response performance - this will continue through 2016 El Nino season. • Algorithm allowed POMMS output to a fire danger model - National Fire Danger Rating System and shared with broader fire science community. • Working to develop PG&E Fire Index ratings and make operational in pilot system for 2016 fire season.
6	1st Triennial (2012-2014)	PG&E	1.06 Demonstrate communication systems allowing the CAISO to utilize available renewable generation flexibility	TBD	Project is currently on-hold.
7	1st Triennial (2012-2014)	PG&E	1.07 Demonstrate systems to ramp existing gas-fired generation more quickly to adapt to changes in variable energy resources output. Formally Withdrawn. CPUC A.12-11-003.	N/A	Formally Withdrawn
8	1st Triennial (2012-2014)	PG&E	1.08 Distribution System Safety and Reliability through New Data Analytics Techniques	7c - Dynamic optimization of grid operations and resources; including appropriate consideration for asset management and utilization of related grid operations and resource, with cost-effective full cyber security (PU Code §8360) 3a - Maintain/Reduce operations and maintenance costs: With the improved understanding of risk, there could be a better tool for evaluating projects such as asset replacement.	• Project is complete. • Finalized asset risk score algorithm, as well as visualization and decision support system prototype. • Completed user training and testing and evaluation. • Project close report finalized and attached to annual report.
9	1st Triennial (2012-2014)	PG&E	1.09A Close proximity switching	5a - Outage number, frequency and duration reductions. 5e - Utility worker safety improvement and hazard exposure reduction	• Project is in Close-out Phase. • Completed testing of robotic arm prototype from 3 vendors, and created benefits/weaknesses guidance, which will be shared with the wider IOU community. • Next steps are to complete final report.

Row #	Investment Program Period	Program Administrator	Project Name	Applicable metrics	Update
	A	B	C	AC	AD
10	1st Triennial (2012-2014)	PG&E	1.09B and 1.10B - Network Conditioned-Based Maintenance	1c - Avoided procurement and generation costs. 3a - Maintain/Reduce operations and maintenance costs.	• Project is in Build/Test Phase. • Completed competitive bidding for the identified research areas and awarded contract. • Kicked off project with consultant and PG&E team members. • Defined scope and started accelerated component testing (non-destructive). • Next steps are to complete testing, and based on the results, design parameters for the next set of testing for component life cycle, to drive cost-based recommendations for system improvements.
11	1st Triennial (2012-2014)	PG&E	1.09C Discrete Reactors	7d - Deployment and integration of cost-effective distributed resources and generation, including renewable resources (PU Code §8360) 5a - Outage number, frequency and duration reductions 5b - Electric system power flow congestion reduction 3a - Maintain/Reduce operations and maintenance costs	• Project is in Build/Test Phase. • Selected the Las Positas-Newark 230 kV line (including tensile strength tests, identification of acceptable structures and spans for install). • Ordered, received, installed DSR units and Power Line Commander Server with a communications link for monitor and control of the DSRs. • Next steps are to perform testing, data collection and complete analysis and recommendations.
12	1st Triennial (2012-2014)	PG&E	1.10A Dissolved Gas Analysis	TBD	Project is currently on-hold.
13	1st Triennial (2012-2014)	PG&E	1.10C Underground Cable Analysis	TBD	Project is currently on-hold.
14	1st Triennial (2012-2014)	PG&E	1.11 Demonstrate self-correcting tools to improve system records and operations	TBD	Project is currently on-hold.
15	1st Triennial (2012-2014)	PG&E	1.12 Demonstrate New technologies that improve wildlife safety and protect assets from weather-related degradation	TBD	Project is currently on-hold.

Row #	Investment Program Period	Program Administrator	Project Name	Applicable metrics	Update
	A	B	C	AC	AD
16	1st Triennial (2012-2014)	PG&E	1.13 Demonstrate new communication systems to improve substation automation and interoperability	TBD	Project is currently on-hold.
17	1st Triennial (2012-2014)	PG&E	1.14 Next Generation SmartMeter Telecom Network Functionalities	7f - Deployment of cost-effective smart technologies, including real time, automated, interactive technologies that optimize the physical operation of appliance and consumer devices for metering, communications concerning grid operations and status, and distribution automation (PU Code §8360). 7k - Develop standards for communication and interoperability of appliances and equipment connected to the electric grid, including the infrastructure serving the grid (PU Code §8360). Note: Each technology demonstrated may have additional specific benefits to name. For instance, the following could apply: improved communication for power restoration, improved control of streetlights, etc.	• Project is in Build/Test Phase. • Completed 13 use cases, including Adaptive control streetlights, Mixed data use, Outage message analyses, etc. • Remaining initiatives include improving Storm Center and restoration response, demonstrating communication with Distribution Automation (DA) devices, and demonstrating Smart Pole streetlight use case to remotely read the energy usage from telecommunications equipment and bill the equipment owner. .
18	1st Triennial (2012-2014)	PG&E	1.15 Grid Operations Situational Intelligence	5a - Outage number, frequency and duration reductions. 7b - Increased use of cost-effective digital information and control technology to improve reliability, security and efficiency of the electric grid (PU Code 8360). 3a - Maintain/Reduce operations and maintenance costs.	• Project is in Build/Test Phase. • Completed Beta go-live in one Control Center and the Emergency Operations Center. • Successfully built in-house Distributed Generation Dashboard. • Next steps are to pilot in front of Operators, and collect data of lessons learned for close-out report.

Row #	Investment Program Period	Program Administrator	Project Name	Applicable metrics	Update
	A	B	C	AC	AD
19	1st Triennial (2012-2014)	PG&E	1.16 Vehicle-to-grid Operational Integration	5a - Outage number, frequency and duration reductions 5e - Utility worker safety improvement and hazard exposure reduction 3a - Maintain/Reduce operations and maintenance costs. 4a - GHG emissions reductions (MMTCO2e)	• Project is in Build/Test Phase. • Leveraged National Renewable Energy Lab test facilities and funding for development tests. • Used VOGSS vehicles for temporary power in real relief efforts during Northern California wild fires. • Beta stage power export vehicles sourced and nearing build completion. • Next steps are to complete electric operations field service testing and grid connection process development, with data collection and closeout.
20	1st Triennial (2012-2014)	PG&E	1.17 Industry participation to leverage EPIC dollars	TBD	Project is currently on-hold.
21	1st Triennial (2012-2014)	PG&E	1.18 Appliance-Level Load Disaggregation	1f - Avoided customer energy use 1h - Customer bill savings (dollars saved)	• Project is in Close-out Phase. • Executed load disaggregation demonstration for ~500 customers. • Evaluated the quality of three vendors' disaggregation algorithm results. • Completed customer surveys and focus groups to evaluate perception and satisfaction of information. • Next steps are to complete final report.
22	1st Triennial (2012-2014)	PG&E	1.19 Enhanced Data Techniques and Capabilities via the SmartMeter™ Platform	7f - Deployment of cost-effective smart technologies, including real time, automated, interactive technologies that optimize the physical operation of appliance and consumer devices for metering, communications concerning grid operations and status, and distribution automation 1h - Customer bill savings (dollars saved) 1f - Avoided customer energy use (KWh saved) 7b - Increased use of cost-effective digital information and control technology to improve reliability, security and efficiency of the electric grid.	• Project is in Staging Phase. • Completed two use cases. • Proved ability to collect power quality data, read meters in remote locations, add new data channels to SmartMetersTM, and detect Line Side Tap energy diversion cases with voltage and usage data. • Next steps are to complete all use cases and complete final report.
23	1st Triennial (2012-2014)	PG&E	1.20 Demonstrate the benefits of providing the competitive, open market with automated access to customer-authorized SmartMeter™ data to drive innovation.	N/A	Formally notified CPUC on 10-31-13, project may be terminated as refined scope does not appear to meet safety, reliability, affordability guiding principles for priority R&D.

Row #	Investment Program Period	Program Administrator	Project Name	Applicable metrics	Update
	A	B	C	AC	AD
24	1st Triennial (2012-2014)	PG&E	1.21 Automatic Identification of Distributed Photovoltaic (PV) Resources	5d - Public safety improvement and hazard exposure reduction 5f - Reduced flicker and other power quality differences 5c - Forecast accuracy improvement	• Project is in Design/Engineering Phase. • Completed customer surveys to potential UIs that were used as feedback to verify functionality of the algorithm. • Improved accuracy of PV identification (ID) and unauthorized interconnections algorithm, and developed method to estimate PV system size. • Next steps are to finalize probabilistic algorithm that has the potential to enable ID of other DERs and complete final report.
25	1st Triennial (2012-2014)	PG&E	1.22 Electric Vehicle Submetering	4a - GHG emissions reductions (MMTCO2e) 1h - Customer bill savings (MWh saved)	• Project in Build/Test phase. • Closed enrollment on 8/31/15 with 132 pilot participants and three Meter Data Management Agents (MDMAs). • Executed competitive RFP and selected vendor to act as third party evaluator. • Next steps include working with IOUs, CPUC and MDMAs to scope, define and launch Phase 2 of the project, as well as obtain evaluation results from Nexant.
26	1st Triennial (2012-2014)	PG&E	1.23 Photovoltaic (PV) Submetering	5c - Forecast accuracy improvements 7b - Increased use of cost-effective digital information and control technology to improve reliability, security and efficiency of the electric grid (PU Code 8360)	• Project is in Build/Test Phase. • Completed lab testing and developed process to receive and display solar generation estimates for 10,000 PV systems from third-party solar tool. • Deployed sub-meters to measure accuracy of estimated solar generation algorithm. • Tested and launched My Energy website with PV generation data for 10,000 customers in 2015. • Next steps are to analyze estimated accuracy compared to sub-meters, as well as collect and summarize customer feedback.
27	1st Triennial (2012-2014)	PG&E	1.24 Demand-Side Management (DSM) for Transmission and Distribution (T&D) Cost Reduction	4A - GHG emissions reductions (MMTCO2e) 1h - Customer bill savings (MWh saved) 7b - Increased use of cost-effective digital information and control technology to improve reliability, security and efficiency of the electric grid (PU Code 8360)	• Project is in Close-out Phase. • Project team has deployed and tested all 600 real time data loggers. • Finalized build and testing of Real-Time Monitoring System (RTMS) dashboard. • Developed and implemented RTMS test plan, including collection and analysis of event data.

Row #	Investment Program Period	Program Administrator	Project Name	Applicable metrics	Update
	A	B	C	AC	AD
28	1st Triennial (2012-2014)	PG&E	1.25 Direct Current (DC) Fast Charging Mapping	3a - Maintain/Reduce capital costs 3d - Number of operations of various existing equipment types before and after adoption of a new smart grid component, as an indicator of possible equipment life extensions from reduced wear and tear 7l - Identification and lowering of unreasonable or unnecessary barriers to adoption of smart grid technologies, practices, and services.	• Project is in the Design/Engineering phase. • Project kicked-off and partners identified. • Completed competitive bid process and selected vendor to develop method for site selection. • Finalized literature review and interviews, as well as the algorithm methodology for rank ordering site locations for placement of the DC fast chargers. • Next steps are to finalize identification of ~200-500 DCFC locations across PG&E's territory.
29	1st Triennial (2012-2014)	PG&E	1.26 Pilot measurement and telemetry strategies and technologies that enable the cost-effective integration of mass market Demand Response (DR) resources into the CAISO wholesale market	TBD	Project is currently on-hold.
30	2nd Triennial (2015-2017)	PG&E	2.01 Evaluate storage on the distribution grid	TBD	Project is currently on-hold.
31	2nd Triennial (2015-2017)	PG&E	2.02 Pilot Distributed Energy Management Systems (DERMS)	7b. Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (PU Code § 8360) 7d. Deployment and integration of cost-effective distributed resources and generation, including renewable resources (PU Code § 8360)	• Project is in Plan/Analyze Phase. • Benchmarked DERMS strategy and pilots with other leading U.S. utilities. • Completed competitive bid process and selected vendor. • Next steps are to sign contract with vendor and execute use cases.

Row #	Investment Program Period	Program Administrator	Project Name	Applicable metrics	Update
	A	B	C	AC	AD
32	2nd Triennial (2015-2017)	PG&E	2.03A Test Smart Inverter Enhanced Capabilities - Photovoltaics (PV)	3a. Maintain / Reduce operations and maintenance costs. 7d. Deployment and integration of cost-effective distributed resources and generation, including renewable resources	• Project is in Plan/Analyze Phase. • Identified short list of substations and feeders to propose for site location. • Next steps are to finalize smart inverter testing, select transformer bank/feeders for deployment, select vendor, and commence field deployment of smart inverters.

Row #	Investment Program Period	Program Administrator	Project Name	Applicable metrics	Update
	A	B	C	AC	AD
33	2nd Triennial (2015-2017)	PG&E	2.03B Test Smart Inverter Enhanced Capabilities - Electric Vehicle (EV)	3a. Maintain / Reduce operations and maintenance costs. 7d. Deployment and integration of cost-effective distributed resources and generation, including renewable resources	• Project is in Plan/Analyze Phase. • Identified potential site location and partner to execute project. • Next steps are to finalize partner, execute SOW, and commence testing.
34	2nd Triennial (2015-2017)	PG&E	2.04 DG monitoring & voltage tracking	3a. Maintain / Reduce operations and maintenance costs 7b - Increased use of cost-effective digital information and control technology to improve reliability, security and efficiency of the electric grid (PU Code 8360) 7d. Deployment and integration of cost-effective distributed resources and generation, including renewable resources	• Project is in Plan/Analyze Phase. • Established success criteria for Phase 2-5. • Next steps are to plan for and execute vendor selection process and develop algorithm.
35	2nd Triennial (2015-2017)	PG&E	2.05 Inertia response emulation for DG impact improvement	TBD	Project is currently on-hold.
36	2nd Triennial (2015-2017)	PG&E	2.06 Intelligent Universal Transformer (IUT)	3a. Maintain / Reduce operations and maintenance costs 3b. Maintain/Reduce capital costs 5d. Public safety improvement and hazard exposure reduction 7k. Develop standards for communication and interoperability of appliances and equipment connected to the electric grid, including the infrastructure serving the grid 7l. Identification and lowering of unreasonable or unnecessary barriers to adoption of smart grid technologies, practices, and services.	• Project is in Plan/Analyze Phase. • Next steps are to identify partners/vendors, select site, develop testing protocols, finalize component build, complete field testing and monitoring, and analyze results.
37	2nd Triennial (2015-2017)	PG&E	2.07 Real time loading data for distribution operations and planning	7b. Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid	• Project is in Plan/Analyze Phase. • Next steps are to prepare vendor requirements, execute competitive bid process and develop algorithm.
38	2nd Triennial (2015-2017)	PG&E	2.08 “Smart” monitoring and analysis Tools	TBD	Project is currently on-hold.

Row #	Investment Program Period	Program Administrator	Project Name	Applicable metrics	Update
	A	B	C	AC	AD
39	2nd Triennial (2015-2017)	PG&E	2.09 Distributed Series Impedance (DSI) (Phase 2)	TBD	Project is currently on-hold.
40	2nd Triennial (2015-2017)	PG&E	2.10 Emergency preparedness modeling	3a. Maintain / Reduce operations and maintenance costs 4a. GHG emissions reductions (MMTCO2e) 5a. Outage number, frequency and duration reductions 5d. Public safety improvement and hazard exposure reduction 5e. Utility worker safety improvement and hazard exposure reduction 5c. Forecast accuracy improvement	• Project is in Plan/Analyze Phase. • Next steps are to complete competitive bid process, select vendor, gather data, and develop resource allocation algorithm/tool.
41	2nd Triennial (2015-2017)	PG&E	2.11 New mobile technology & visualization applications	TBD	Project is currently on-hold.
42	2nd Triennial (2015-2017)	PG&E	2.12 New Emergency management mobile applications	TBD	Project is currently on-hold.
43	2nd Triennial (2015-2017)	PG&E	2.13 Digital substation/substation automation	TBD	Project is currently on-hold.
44	2nd Triennial (2015-2017)	PG&E	2.14 Automatically map phasing information	7b. Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid	• Project is in Plan/Analyze Phase. • Next steps are to execute competitive bid process and develop algorithm/analytics options.

Row #	Investment Program Period	Program Administrator	Project Name	Applicable metrics	Update
	A	B	C	AC	AD
45	2nd Triennial (2015-2017)	PG&E	2.15 Synchrophasor applications for generator dynamic model validation	3a. Maintain / Reduce operations and maintenance costs 5a. Outage number, frequency and duration reductions 7b. Increased use of cost-effective digital information and control technology to improve reliability, security and efficiency of the electric grid (PU Code 8360)	• Project is in Plan/Analyze Phase. • Next steps are to identify appropriate test facilities/ geography, contract with additional vendors, install Synchrophasors, and test.

Row #	Investment Program Period	Program Administrator	Project Name	Applicable metrics	Update
	A	B	C	AC	AD
46	2nd Triennial (2015-2017)	PG&E	2.16 Enhanced Synchrophasor analytics & applications	TBD	Project is currently on-hold.
47	2nd Triennial (2015-2017)	PG&E	2.17 Geomagnetic Disturbance (GMD) evaluation	TBD	Project is currently on-hold.
48	2nd Triennial (2015-2017)	PG&E	2.18 Optical instrument transformers and sensors for protection and control systems	TBD	Project is currently on-hold.
49	2nd Triennial (2015-2017)	PG&E	2.19 Enable distributed demand-side strategies & technologies	1c. Avoided procurement and generation costs 1i. Nameplate Capacity of Grid-Connected Storage 3f. Improvements in system operation efficiencies stemming from increased utility dispatchability of customer demand side management 5b. Electric system power flow congestion reduction 5d. Public safety improvement and hazard exposure reduction 7b. Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid 7d. Deployment and integration of cost-effective distributed resources and generation, including renewable resources	• Project is in Plan/Analyze Phase. • Identified a short list of substations and feeders to propose for site location. • Next steps are to select transformer bank/feeders for deployment, complete RFP to select vendor, develop contracts, acquire customer participants and commence field deployment of BTM batteries.
50	2nd Triennial (2015-2017)	PG&E	2.20 Real-time energy usage feedback to customers	TBD	Project is currently on-hold.
51	2nd Triennial (2015-2017)	PG&E	2.21 Home Area Network (HAN) for commercial customers	1e. Peak load reduction (MW) from summer and winter programs 1f. Avoided customer energy use (kWh saved) 1h. Customer bill savings (dollars saved) 3a. Maintain / Reduce operations and maintenance costs 4a. GHG emissions reductions (MMTCO2e) 7b. Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (PU Code § 8360)	• Project is in Plan/Analyze Phase. • Developed business plan and identified vendor/partner. • Next steps are to complete design, build and test phases, including customer site identification, lab testing, deployment of devices, field testing and integration with EMS.

Row #	Investment Program Period	Program Administrator	Project Name	Applicable metrics	Update
	A	B	C	AC	AD
52	2nd Triennial (2015-2017)	PG&E	2.22 Demand reduction through targeted data analytics	3a. Maintain / Reduce capital costs 7b. Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid 7e. Development and incorporation of cost-effective demand response, demand-side resource, and energy efficient resources 7h. Deployment and integration of cost-effective advanced electricity storage and peak-shaving technologies, including plug-in electric and hybrid electric vehicles, and thermal-storage air-conditioning	• Project is in Plan/Analyze Phase. • Identified data integration and analytics platform vendor and narrowed grid assets to be analyzed in the project. • Next steps are to complete data gathering, integrate or staging of datasets, develop analytics platform, create quantitative screening tool, and build interface with targeted DER sales guidance.
53	2nd Triennial (2015-2017)	PG&E	2.23 Integrate demand side approaches into utility planning	1c. Avoided procurement and generation costs 3f. Improvements in system operation efficiencies stemming from increased utility dispatchability of customer demand side management 5c. Forecast accuracy improvement 7e. Development and incorporation of cost-effective demand response, demand-side resources, and energy-efficient resources (PU Code § 8360)	• Project is in Build/Test Phase. • Developed Statement of Work (SOW) and selected vendor, completed initial data transfer to vendor, and incorporated enhanced customer and DER load shapes catalog into LoadSEER planning tool. • Next steps are to incorporate DER scenario projections into LoadSEER, complete user acceptance testing, develop interface between LoadSEER and CYME, and develop the integrated capacity analysis modules within LoadSEER.
54	2nd Triennial (2015-2017)	PG&E	2.24 Appliance level bill disaggregation for non-residential customers	TBD	Project is currently on-hold.
55	2nd Triennial (2015-2017)	PG&E	2.25 Enhanced Smart Grid Communications	TBD	Project is currently on-hold.
56	2nd Triennial (2015-2017)	PG&E	2.26 Customer & distribution automation open architecture devices	3f. Improvements in system operation efficiencies stemming from increased utility dispatchability of customer demand side management 5i. Increase in the number of nodes in the power system at monitoring points 7j. Provide consumers with timely information and control options	• Project is in Plan/Analyze Phase. • Next steps are to review and approve business plan, develop use cases, then design, build, and test.
57	2nd Triennial (2015-2017)	PG&E	2.27 Next generation integrated Smart Grid network management	3a. Maintain / Reduce operations and maintenance costs 5a. Outage number, frequency and duration reductions 5d. Public safety improvement and hazard exposure reduction 5e. Utility worker safety improvement and hazard exposure reduction	• Project is in Plan/Analyze Phase. • Developed business plan and use cases. • Next steps are to complete competitive bid process, evaluate and select vendor(s) and launch design, build and test phases.

Row #	Investment Program Period	Program Administrator	Project Name	Applicable metrics	Update
	A	B	C	AC	AD
58	2nd Triennial (2015-2017)	PG&E	2.28 Smart Grid communications path monitoring	TBD	Project is currently on-hold.
59	2nd Triennial (2015-2017)	PG&E	2.29 Mobile meter applications	3a. Maintain / Reduce operations and maintenance costs (Affordability) 7b. Increased use of cost-effective digital information and control technology to improve reliability, security, and efficiency of the electric grid (Reliability) 7j. Provide consumers with timely information and control options (Customer)	• Project is in Plan/Analyze Phase. • Developed specification for Next Generation Mobile Meter that covers various test use cases (EV charging stations, EVs, and DG). • Next steps are to complete competitive bid process for vendor selection, develop Next Generation Meter prototype, and begin testing.
60	2nd Triennial (2015-2017)	PG&E	2.30 Leverage EPIC funds to participate in industry-wide RD&D programs	TBD	Project is currently on-hold.

PACIFIC GAS AND ELECTRIC COMPANY

APPENDIX B

FINAL REPORT: EPIC 1.08 DISTRIBUTION SYSTEM SAFETY AND RELIABILITY THROUGH DATA ANALYTICS TECHNIQUES

Pacific Gas and Electric Company

EPIC Final Report

Program	***Electric Business Technology***
Project	***EPIC 1 Project 08 – Distribution System Safety and Reliability through New Data Analytics Techniques***
Line of Business or Department	*Electric Operations*
Date	December 1, 2015
Version Type	*Final*

Table of Contents

1.0 Executive Summary

As part of PG&E's Electric Program Investment Charge (EPIC) program, PG&E pursued a demonstration Proof-of-Concept (POC) project aimed to explore how to leverage new data analytic techniques to improve distribution system safety and reliability. The objective of the demonstration was to demonstrate a visualization and decision support system to support PG&E's risk management efforts to enhance public and system safety as well as improve asset management strategies and investment plans for Electric Operations (EO). The project name is Distribution System Safety and Reliability through New Data Analytics Techniques, the software application demonstrated was the System Tool for Asset Risk (STAR).

The concept of STAR is to integrate electrical asset and system data from multiple sources to calculate individual asset and system risk scores based on severity of risk and probability of occurrence. The data can include asset attributes (age, material type, etc.) asset condition, geography, outage information and other relevant information. A user interface allows employees to review results in a geographical, tabular and graphical format. Figure 1, at the end of this executive summary, illustrates the basic concepts of the STAR application.

The STAR POC focused on four distribution asset classes (substation transformers, substation breakers, distribution primary overhead conductors and distribution wood poles) for risk score calculations. Additional asset classes were included as necessary to model complete circuits or for visual purposes. Along with risk score calculations and the ability to visualize those in multiple formats, other functionality included performing basic what-if analysis, algorithm maintenance, user defined queries, asset aggregation ability (e.g. substation, protective zone) and exporting results. For the purpose of the POC, STAR ingested data in a flat-file format from the various systems (i.e., the POC did not interface directly with source systems such as SAP and GIS, a fully functional STAR application will obtain the necessary data directly from source systems).

Key stakeholders from the asset management organization were engaged in the POC effort. The POC leveraged PG&E's risk management framework to develop risk score algorithms. This ability to focus on higher risk assets should provide insight for identifying work that has the greatest likelihood of improving public safety. While the POC was not used for investment planning purposes it provides the platform to demonstrate potential reduction in costs and improvement in customer reliability through the calculation and visualization of asset and system risk. The information in a production version of STAR would then be able to be used by asset strategists to better inform asset strategies and investment planning.

The evaluation results of the POC were compiled based on the feedback from PG&E personnel. The users participated through multiple demonstrations, training, user acceptance testing (UAT) and ongoing informal testing. User feedback was captured in three evaluation criteria categories: software quality, implementation ability and product usability. Additionally, STAR improvements and challenges relevant for future implementations were documented throughout the POC.

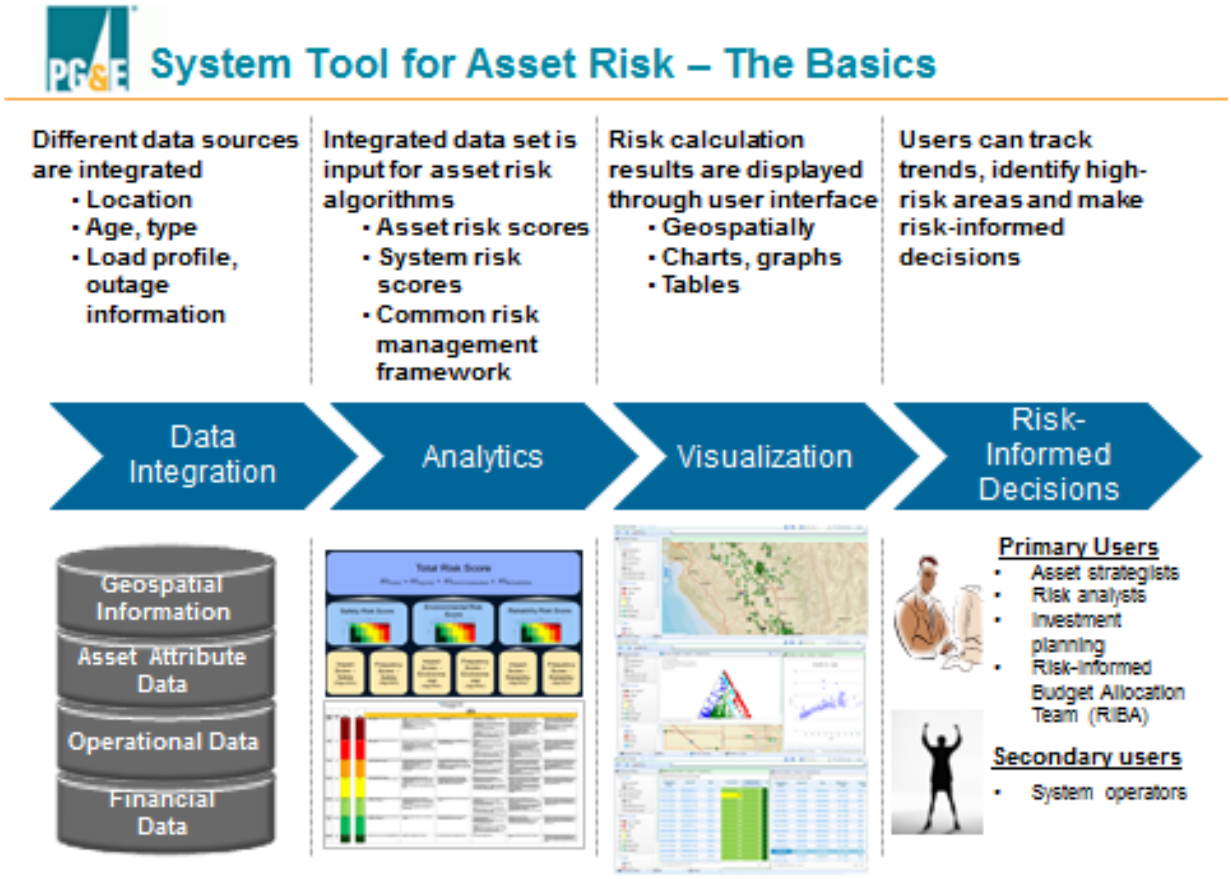
The success of the POC came in several overarching dimensions which will be expanded on throughout this report. The core successes of the POC are as follows:

- Increased understanding of market landscape
- Risk algorithm refinement and development
- Integration of geospatial information into the risk algorithms
- Understanding utility systems and data capabilities/issues

- Exposure of risk analysis technology and thinking to asset strategists and key utility personnel
- Developing robust implementation strategy

The outcome of this EPIC project was a POC demonstration that allows users to visualize asset risk calculations based on an integrated data set from different sources. Some issues were experienced relating to system performance, dashboard visualization and user interface errors, however those were characteristic of a proof of concept approach and PG&E believes the POC demonstrated capabilities which evidence the business value of a production system where these concerns can be addressed. The concepts here in the POC will have general applicability to not only California utilities but also the industry at large as it provides a demonstration of how ever-increasing amounts of data can be mined and combined for targeted, cost-effective use for system asset risk management leading to improved distribution system safety and reliability.

Figure 1. STAR Basics



2.0 Introduction

On November 1, 2012, in A.12-11-003, PG&E filed its first triennial Electric Program Investment Charge (EPIC) Application at the CPUC, requesting $49,328,000 including funding for 26 Technology Demonstration and Deployment Projects. On November 14, 2013, in D.13-11-025, the CPUC approved PG&E's EPIC plan, including $49,328,000 for this program category. Pursuant to PG&E's approved EPIC triennial plan, PG&E initiated, planned and implemented the following project: EPIC1.08 Distribution System Safety and Reliability through New Data Analytics Techniques, also known as the System Tool for Asset Risk (STAR). Through the annual reporting process, PG&E kept CPUC staff and stakeholders informed on the progress of the project. The following is PG&E's final report on this project.

3.0 Problem Being Addressed

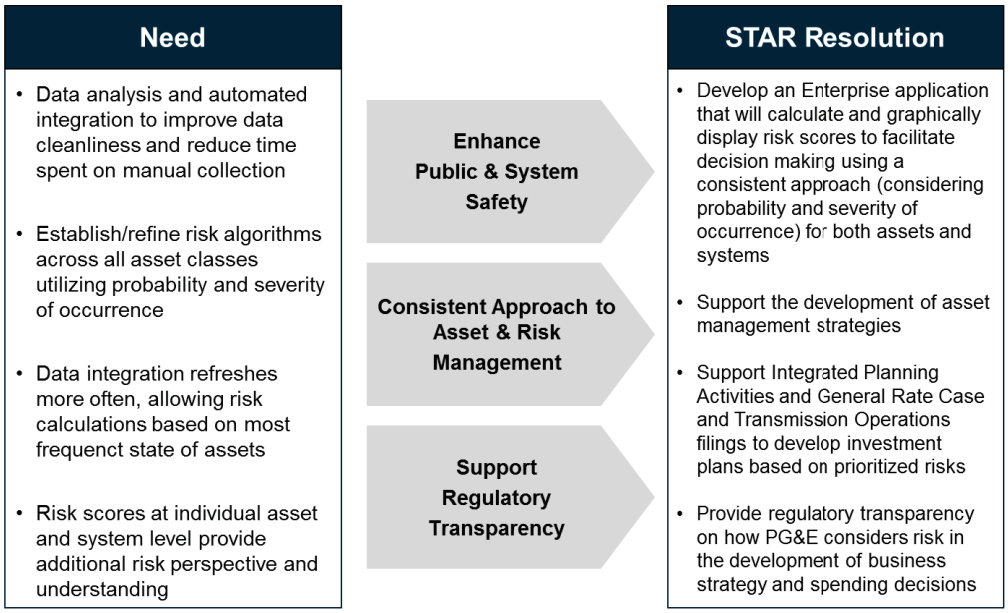
PG&E is implementing a risk management framework to enhance public and system safety. In order to foster a consistent approach and provide transparency in the regulatory process it is appropriate to investigate how technology can automate and support the effort. PG&E currently analyzes risk for a subset of assets utilizing a subset of data across multiple systems. These analyses leverage one off spreadsheets and calculation methodologies and require manual collection and consolidation of data. These current processes are time consuming, manually-intensive, and disruptive to ongoing operations. At the same time, the amount of data inside the utility continues to grow exponentially. A standardized approach to asset and system risk scores for a larger number of asset classes and systems that are enabled by technology for faster more thorough analytics will enable the continued development of this risk management framework.

PG&E wants to leverage additional internal and external data sources to continue to refine the risk algorithms for a variety of asset classes. PG&E risk algorithms will continue to evolve with the ability to ingest operational data and geospatial information such as population density and wind and snow loading maps. The ability to geospatially visualize asset and systems throughout the service territory and the interaction between geospatial information and the risk algorithms enables asset strategists to make confident and consistent decisions. Using all data appropriate and available to calculate asset and system risk scores will also help develop robust risk calculations.

The automated integration of data across disparate source systems will reduce the time spent collecting and consolidating data across PG&E. Manual manipulation of data and formulas in spreadsheets are prone to errors and inconsistent results. An application that integrates the necessary data and uses it in PG&E standard risk algorithms reduces the likelihood of errors and promotes consistent decisions. Ultimately, the STAR demonstration POC proved the concept of applying multiple data sources and risk scoring to enhance effective risk management for a subset of electric distribution, substation and line assets for a portion of PG&E's service territory.

Figure 2 below summarizes the issues/needs and how technology can provide a resolution.

Figure 2
Needs & Resolutions



3.1 Overview

PG&E is pursuing a risk-based asset management strategy to enhance public and system safety. As part of this pursuit, PG&E created the proof of concept system called STAR as an EPIC initiative to demonstrate and study an information system that calculates asset and system risk scores based on severity of risk and probability of occurrence. This project was ideal for the EPIC program since there are few vendors in this space, and the ability to leverage "big data" for better asset management in utilities is a new technology that has not been proven / implemented in large scale. The asset risk scores created through the program's algorithms can be used to inform asset management strategies, investment plans and ad-hoc analysis. This type of system is not only new to PG&E, but also to the utility industry.

The STAR POC:

- Calculates asset health indices and risk scores
- Represents the risk scores geospatially and graphically
- Facilitates risk analysis at an asset and system level

3.2 POC Scope

To demonstrate the feasibility and usefulness of STAR as well as its potential benefits, PG&E decided to move forward with a POC. A set of requirements was created and a request for proposals (RFP) was issued in March, 2014. Multiple vendors submitted proposals and a selection was made to create a POC.

Requirements originating from relevant business processes were used to establish STAR functionality for the four asset classes in scope. From August 2014 to February 2015, the software vendor worked with PG&E personnel to build a risk analysis tool for users to evaluate areas such as user-interface experience, advanced analytic capabilities, data management and technical specifications (e.g. scalability, integration, etc.). Below is a high-level outline of the prototype requirements:

Schedule

- POC development ran from August 2014 until February 2015
- POC evaluation ran from February 2015 until April 2015
- Report preparation ran from April 2015 to September 2015

Functionality

- Calculate and display risk scores using PG&E defined algorithms at both an individual and aggregate asset level (substation, circuit, sub-circuit, or asset-type)
- Ability to perform low level of "what-if" analysis (e.g., weighting risk factors)
- Demonstrate how algorithms can be modified for "what-if" analysis (using R language)
- Able to prepare some user defined reports/queries and export results

User Interface

- The POC user interface was representative (but not necessarily a final version) of what the STAR production tool will look like.
    - Asset selection by type and "system" (substation, circuit, protection zone, all poles, etc.)
    - Display results both geospatially and graphically (e.g., assets coloured by risk score), in tables and via multiple visual formats (bar graphs, scatter charts, etc.)
    - Show how risk scores change based on asset selection
    - Export tabular data (i.e., into excel, etc.)

Geographic & Asset Scale

- The POC included assets from the Central Valley region where PG&E has implemented its new EDGIS system.
- The POC included four asset types:
    - Distribution poles
    - Primary overhead conductor
    - Distribution substation transformers
    - Distribution breakers
- Additional assets were included for visualization purposes only.

Architecture

- The POC was hosted in an environment offsite and utilized cloud services to access the application.

Data Sources

- A flat file approach was utilized to load data from multiple sources into the STAR database. More detail is available in the data sources section below.

3.3 Source Data

The value of a future production version of STAR will be commensurate with the level of integration between STAR and core enterprise data systems, as well as the ability of STAR to link risk outputs

between these systems geospatially and in dashboards (tables, charts, dials). To minimize the level of complexity required for a fully integrated STAR solution, a flat file approach was utilized for the POC. Various exports from the source databases were ingested into the STAR POC instead of an integrated enterprise architecture that will be necessary for a STAR production system.

PG&E evaluated and determined the source data systems that would be utilized in the STAR POC.

STAR POC Data Sources:

- Electric Distribution Geographic Information System (EDGIS)
- ERP (Financials, Supply Chain, Work & Asset Management)
- Outage Database (outages, customer interruptions, customer minutes)
- Aspen Oneliner (transmission fault duty)
- CYME (Distribution load flow)
- Splice Dataset (field collected information on in-line primary splices)
- Delta X (Substation equipment condition information)
- Offline Datasets (Excel)

The STAR POC scope included four asset types that were used for visualization, analysis and validation. Those assets were:

- Distribution Poles
- Distribution Overhead Primary Conductors
- Distribution Substation Transformers
- Distribution Breakers

Table 1 below shows the relationship between data source systems and the prototype assets.

Table 1
STAR POC Source Systems

	Source Systems							
	Electric Distribution Geographic Information System (EDGIS)	ERP (Financials, Supply Chain, Work & Asset Management)	Outage Database	Aspen Oneliner	CYME	Splice Inventory	Delta-X	Offline Databases (Excel)
Poles	✓	✓	✓	✗	✗	✗	✗	✗
Conductors	✓	✓	✓	✗	✓	✓	✗	✓
Distribution Sub Transformers	✓	✓	✓	✓	✗	✗	✓	✓
Distribution Sub Breakers	✓	✓	✓	✗	✗	✗	✓	✓

Table 2 provides an approximate number of core assets that were available for analysis in the POC. Additional asset details, including attributes, can be found in the appendix.

Table 2
Asset Counts

Asset Type	Count
Distribution Wood Poles	591,237
Distribution Overhead Primary Conductor (Line Sections)	423,392
Distribution Substation Transformers	290
Distribution Breakers	1949

Additional assets and information were included for visualization purposes to represent a complete distribution circuit:

- Distribution Underground Primary Conductors
- Distribution Overhead Protective Devices (i.e. Reclosers, Fuses, Sectionalizers, Interrupters)
- Distribution Overhead Line Switches
- Distribution Overhead Line Transformers
- Substation Locations
- Substation Single Line Diagrams

The most significant data source for STAR is PG&E's GIS. The company is currently implementing an updated EDGIS. During the data ingestion of the STAR POC, the new EDGIS was only available in the Central Valley Region (this region includes the area from approximately Bakersfield to Stockton in the San Joaquin Valley of California). Consequently, the POC only used data from that area.

3.3.1 Data Access

Upon request, PG&E will provide access to data collected that is consistent with the CPUC's data access requirements for EPIC data and results.

3.4 Data Quality

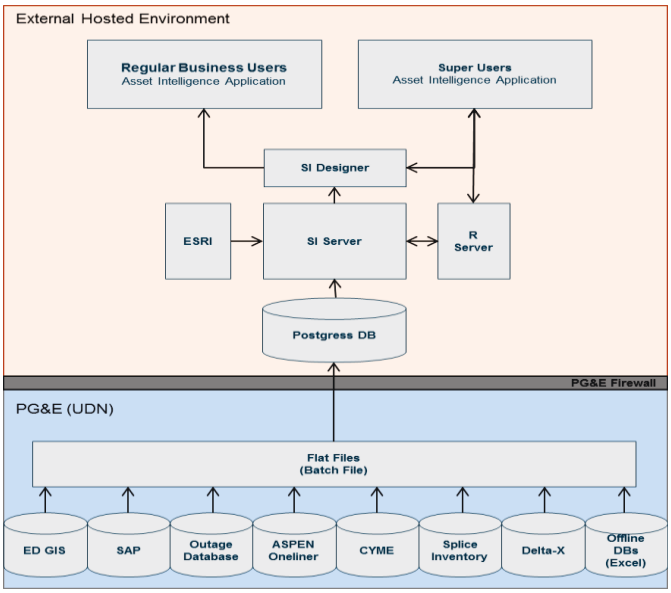
The effectiveness of STAR depends on the accuracy and completeness of the utilities data. It is important to fully understand source data quality and availability. PG&E is aware of source data challenges and the potential effect they can have on a STAR production system. One of the results of the POC is further insight into specific data concerns. Source datasets were vetted to provide insight into the POC data capabilities and issues were documented for a greater understanding of future challenges. STAR provides a framework for better understanding data requirements as they relate to asset risk.

Another learning from the POC to address data quality issues was the concept of applying confidence factors to risk scores.This approach will help users understand the robustness of the asset and system risk scores. High, medium and low confidence factors were established by determining the completeness of the source data used in the calculations. Risk scores with high confidence factors indicate a more robust risk score relative to those with a low confidence factor. Low confidence factors will indicate to users that additional analysis may be required. Moving forward there will be an effort to improve on the confidence factor and review options for reporting data issues back to source systems to assist with data enhancement activities.

3.5 Architecture

To simplify the data migration process, it was decided to perform a data extract out of the PG&E systems and load that data to the POC environment database. It is recognized that this approach is not relevant for a production system solution but provides sufficient information for a demonstration POC evaluation. A STAR production system solution will require enterprise system integration and a periodic data exchange between environments, which will require deeper, more costly IT integration. The following diagram is the high level data architecture utilized for the STAR POC.

Figure 3
STAR POC Architecture



3.6 PG&E Enterprise Operational Risk Management Program

To support the timely creation of the risk algorithms for the STAR POC, the project used components of the PG&E Enterprise Operations Risk Management (EORM) framework process as a starting point in the development of the STAR asset risk algorithms. The STAR POC algorithms were not used to make any investment portfolio decisions. Rather the algorithms provided a means to evaluate the capabilities of the vendor application and continue refining asset and system risk models.

The EORM program developed the use of a Risk Evaluation Tool (RET) which facilitates comparison of risks both within lines of business, and across lines of business. The risk evaluation tool employs a 7 x 7 matrix (see Figure 4) where potential impacts of the risk scenario are scored across six impact categories and one frequency category. The impact categories are: Safety, Environmental,

Compliance, Reliability, Trust and Financial. Once the impact and frequency scores are articulated, the algorithm is applied to calculate a risk score[1].

Figure 4
RET 7 x 7 Matrix

Frequency Description	Frequency per Year	Frequency Level	Impact Level
> 10 times per year	F = > 10	**Common (7)**	**Catastrophic (7)**
1 - 10 times per year	F = 1 - 10	**Regular (6)**	**Severe (6)**
Once every 1 - 3 years	F = 1 - 0.3	**Frequent (5)**	**Extensive (5)**
Once every 3 - 10 years	F = 0.3 - 0.1	**Occasional (4)**	**Major (4)**
Once every 10 - 30 years	F = 0.1 - 0.033	**Infrequent (3)**	**Moderate (3)**
Once every 30 - 100 years	F = 0.033 - 0.01	**Rare (2)**	**Minor (2)**
Once every 100+ years	F = < 0.01	**Remote (1)**	**Negligible (1)**

Impact Categories:

- Safety
- Environmental
- Compliance
- Reliability
- Trust
- Financial

In addition to the RET, PG&E employs a Risk Informed Budget Allocation (RIBA) process to inform the prioritization of budget for risk mitigation measures and other work in its portfolio. RIBA scores are calculated for projects in an excel model. The RIBA process scores projects along three of the six RET impact categories: Safety, Environmental, Reliability and three frequency scores (one for each impact dimension).

Similar to the RIBA process, the STAR POC risk algorithms are calculated based on three impact dimensions: Safety, Reliability and Environmental. A frequency and impact score is determined for each impact category, these frequency and impact scores are inputs into a risk score equation which determines the individual risk score for each category. The total risk score for each asset is the summation of the individual risk scores for each asset. A detailed risk calculation walkthrough for the four asset classes is provided in the appendix.

[1] For more information please refer to PG&E's testimony in the Safety Model Assessment Proceeding (A. 15.05.003).

4.0 STAR POC Results

4.1 Evaluation Process

Upon completion of the STAR POC project, an evaluation phase commenced. The purpose of the evaluation was to understand the POC results in order to apply the knowledge gained to a possible future production system. To gain a comprehensive understanding of the POC success, it was necessary that each user's experience with the product be understood. There were 13 users that interacted with the POC through the following activities:

- Sprint demos (4)
- Ongoing informal software testing
- User Acceptance Testing (UAT)

Individual documented results from the UAT (unexpected & desired results) as well as user interviews based on experience with the product throughout the POC provided important details for the evaluation. An evaluation criteria worksheet along with a supporting PowerPoint deck was used to capture the feedback.

4.2 Evaluation Criteria

The evaluation criteria worksheet established 19 criteria (see below) grouped into three categories: (1) Software Quality (2) Implementation Ability and (3) Product Usability. Input from both business and IT users provided details for the PG&E experience with the STAR POC. Based on the results, potential mitigations were identified for both the POC and a potential production version of STAR.

Software Quality Criteria

- Performance
- Reliability
- Visualization
- Analytics (Algorithms)
- Maintainability
- Interoperability
- Functionality

Implementation Ability Criteria

- Customize Functionality
- Customize Usability
- Ingesting Source Data
- Timeliness
- Project Management
- Communication
- Meet Requirements
- Training

4.3 Evaluation Results

The evaluation in the areas of software quality, implementation ability and product usability provide mixed results. There were positives in the ability to quickly stand up an application to visualize asset risk and flexibility with compiling data and calculating results. The POC application provided an imperative tool for communicating the future vision and refining business processes and functional requirements. Negative feedback included slow initial system performance due to the POC being hosted in a cloud environment, as well as an abbreviated process for refining and optimizing how data is accessed (e.g., what data elements are retrieved and at what time in the workflow) both of which are attributable to the nature of creating a POC. Overall, the POC provided users with a significant amount of knowledge in the potential of STAR and will be able to apply many lessons learned going forward.

4.3.1 Software Quality

The quality of the software product was evaluated using several criteria (see appendix for additional details). The software quality evaluation focused on the base product used for the POC and its alignment with user expectations in several areas.

When reviewing performance and system reliability issues, it should be noted that architecture of the POC differs greatly from the expected architecture of a production system. Differences include cloud based access with a 3rd party responsible for system maintenance vs. the complete system architecture internally housed and maintained by PG&E. Also, the typical effort in system optimization and periodic performance tests was not applied during this project. Finally, while the POC used flat files, the STAR production system solution will require enterprise system integration.

Aspects of the software that met user expectations included visual risk score results on the map and in tables, asset information available to the user, R programming language functionality for algorithm maintenance and the ability to integrate several source datasets for risk analysis. Users were able to effectively navigate the geographic view with panning and zooming tools as well as establish favorites to keep user settings. Tables provided detailed asset information and color coded risk scores that users could create subsets of using querying functions. Also, the vendor was able to quickly stand up an application for some initial asset visualization.

Overall, the users expect an increase in performance from the POC to a production quality system. Users dealt with some performance issues concerning delays with table querying and sorting processes as well as map rendering. Occasionally, application and/or computer restarts and clearing browser caches were required to continue with testing efforts. Application errors and bugs caused different results when performing the same task. Map, table and chart visualization issues were reported regarding symbology and navigation. These results proved that (1) users are engaged in the tool and (2) feedback is crucial to align stakeholder expectations. Despite these observations, there were many lessons learned that will be applied to the solution going forward. PG&E can leverage the POC and the associated findings to better define use cases and user requirements for a production version.

It is worth reiterating that the demonstration POC process moved quickly from concept to product. Due to the nature of a POC, less time was spent in assessment, design and testing activities. This approach resulted in some of the user experiences described above.

4.3.2 Implementation Ability

The implementation of the software product by the vendor was evaluated using several criteria (see appendix for additional details). The evaluation of the implementation ability focused on the outcome of activities necessary for this type of a software implementation.

The vendor worked with PG&E to successfully establish requirements and user stories in an online system that allowed progress to be tracked as well as feedback and bug reporting from the end users. A design document that captured user interfaces, configuration and data migration specifications was created during initial project workshops with PG&E. As PG&E became more aware of product capability and POC needs, additional scope was added to the project. This included demonstrations about how the application accesses substation one-line diagrams (from both EDGIS and engineering drawings) and the implementation of Duval Triangles (which display the results of dissolved gas analysis tests).

The implementation of the STAR POC posed many challenges. Functional requirements mandated that some customization was necessary to meet the POC expectations. It also became evident as the project moved forward that the lack of a system integrator during the POC resulted in some implementation issues. With an agile project management process in place, tasks regarding communication, issue/risk management and schedules were not managed as well as anticipated. Issues reported by users involving processes and intuitiveness of the product can be associated with ineffective communication. Also some issues related to creating the electric distribution circuitry in STAR (i.e., the connectivity model) led to delays which were mitigated in part by the vendor adding additional specialized resources to the project. A key learning from the POC is that the system integrator role is important to maintain project implementation success.

4.3.3 Product Usability

The usability of the product was evaluated using several criteria (see appendix for additional details). The product usability evaluation focused on the intuitiveness of the POC and the alignment with user business processes and relevant risk analysis processes. The scope of the POC did not include consideration regarding the production version of the application in areas of RIBA, EORM or any other relevant activities.

The general feedback was mixed; the users felt that the amount of “mouse clicks” exceeded what they expected for risk assessment exercises. During testing, it became evident that the product didn’t fully provide relevant PG&E work processes to the extent expected for the POC. However, the feedback on product usability was invaluable because it facilitated the discussion between product developers and stakeholders and led to refinements in business requirements. The product documentation was thorough and useful to the user for “OTB” functionality when accessed. There was a supplemental training guide that provided additional documentation on functionality specific to this POC.

Many of the issues related to product usability are directly related to the implementation activities. A condensed design phase, lack of a system integrator, and minimal user interaction during certain software development activities contributed to a product that did not meet all usability expectations. However, PG&E is confident that with the proper project management staffing, a thorough plan/analyze phase that builds on the lessons learned from the POC and increased user involvement; it is possible to create a production version of STAR that aligns with the user’s expectations.

5.0 POC Benefits

5.1 Benefits and Lessons Learned from the POC

The STAR POC yielded the following benefits and lessons learned.

- **Market Landscape:** The POC vendor selection process provided PG&E insight regarding the capabilities of technology firms in the areas of data integration, analysis and visualization for the purpose of using risk analysis in electric utility asset management. At the time of awarding the POC, PG&E concluded that only two of the 12 firms responding to the RFP could deliver a viable POC per the specified schedule and requirements. This indicated to PG&E that firms engaged in this field were limited, re-inforcing that this project was ideal for an EPIC demonstration. Since awarding the POC, PG&E has continued to engage with the analytics, visualization, and situational intelligence market. This has included engagements with other firms for analytic big data projects that pursue different outcomes, such as real-time situational intelligence. PG&E believes the number of vendors capable of providing the necessary solution has continued to increase since 2014 but the market is still maturing.
- **Algorithm Development:** Creating a POC required PG&E to consider how current algorithms (and decision processes) used to inform asset replacement decisions can be adapted to the STAR POC and how a production version of the application can provide a framework to further develop those algorithms. The STAR POC also facilitated the identification of the required analytics skillset. Through the POC, PG&E identified key functional areas needing strengthening in order to ensure full utilization of a STAR production system. These functional areas include data science, statistical analysis and machine learning.
- **Integration of Geospatial Information in the Risk Algorithms:** By ingesting geospatial overlays in the STAR POC such as population density, wind and fire maps, PG&E is able to take a step towards incorporating more advanced geospatial information in the risk calculations.
- **Understanding System and Data Capabilities/Issues:** Deciding on the scope for the POC required PG&E to consider the relationships between disparate systems as well as the quality of the data in those systems. For STAR to be effective in a production system, all source datasets will need to be integrated in an automated data sharing system. By better understanding the data quality of the source datasets, PG&E can determine the appropriate phased approach to establishing a production STAR. PG&E can feel more confident in pursuing risk functionality for assets where the data is more reliable for an initial production phase and establish a strategy to improve relevant asset data for subsequent phases.
- **Exposure of Risk Analysis Technology and Thinking to Asset Strategists:** Utility should have a strong foothold in risk analysis methodologies and how they should be applied to asset and system risk scores. The process of creating an interactive POC provides personnel first-hand knowledge of how that technology applies to improving asset risk algorithms and aligns with business processes. This knowledge will be important when applied to future assess and design activities of a production STAR.
- **Developing a Robust Implementation Strategy:** Learnings from the POC allowed PG&E to start to develop a potential implementation strategy for a production system including understanding the necessary resources required both internally and externally necessary for a successful production implementation. The POC also allowed PG&E to determine if a production system would provide business value and what kind of staged approach would lead to the best results. Detailed analysis and design phases are needed to understand all potential data issues.

6.0 Future of STAR

A production version of the STAR tool is envisioned to be the source system for asset and system risk scores for transmission and distribution (T&D) facilities that: (1) asset management will utilize when developing asset strategies; and (2) will provide insight to regulatory agencies about how PG&E explicitly considers risk in the development of business strategy and planning decisions. STAR primary

users will be Asset Managers and Risk & Compliance teams to support integrated planning activities and ad-hoc analysis.

6.1 Algorithm Improvements from POC to Product

The work done throughout the POC led to important lessons learned for the future of STAR asset and system risk algorithms. As more data is integrated and data science capabilities are strengthened at PG&E, the asset and system risk scores will continue to develop. PG&E has recently established a data scientist track to ensure the internal capabilities are established and maintained. These data scientists will be tasked with using statistical software tools, such as R, to build and refine predictive models for appropriate asset classes. These indivdiuals will enable a more advanced understanding of the probability of failure of assets in PG&E's system while the integration of additional external and internal geospatial data sets will enable more complete consequence of failure calculations. The combination of building advanced analytical capabilities and continuing to leverage PG&E's enterprise risk framework will facilitate a standardized risk model at PG&E which will allow consistent decision making across the organization.

6.2 Benefits Expected with Production System

The benefits expected with the implementation of a STAR production system include:

Table 3
Production System Potential Benefits

Benefit Area	Benefit
Quality of Service	• Improve public safety by identifying and addressing higher risk assets • Reduce in unplanned outages amd customer interruptions • Improve SAIFI / SAIDI
Planning	• Replacement of equipment at non-premium costs due to replacing before failure • Turn unplanned replacements into planned replacements • Avoid unneeded replacements as a result of better information • Increase in productivity due to accelerated analysis/conclusions and increase in transparency and confidence of data • Gain hours or reallocation of hours to do better analysis • Improve ability to scope projects and bundle work • Improve risk informed Capex spending, planning and processes • Alignment with existing risk based processes • Define "effective age" of assets which supports more accurate prediction of future performance of assets and asset classes
Operations	• O&M condition based maintenance using risk information

Other	• Improvement in rate case showings through enhanced risk informed decision making • Increased efficiency in preparing rate cases and responding to data requests. • Increased efficiency in preparing data for internal/external requests/audits/initiatives (risk requests may increase) • Improve communication with stakeholders regarding assets and risks - community, regulatory, public • Improve enterprise collaboration, apply best practices and governance.

The proposed STAR production system will be integrated with other systems to build a platform that will provide asset managers and other users the ability to more effectively evaluate safety, regulatory compliance, and reliability based on the condition of the aging infrastructure and builds the strategy based on priority.

- Economic Benefits
  - Maintain/Reduce operations and maintenance costs
  - Maintain/Reduce capital costs
  - Number of operations of various existing equipment types (such as voltage regulation) before and after adoption of a new smart grid component, as an indicator of possible equipment life extensions from reduced wear and tear

- Safety, Power Quality and Reliability (Equipment, Electricity System)
  - Outage number, frequency and duration reductions
  - Public safety improvement and hazard exposure reduction
  - Utility worker safety improvement and hazard exposure reduction

- Identification of barriers or issues resolved that prevented widespread deployment of technology or strategy
  - Dynamic optimization of grid operations and resources, including appropriate consideration for asset management and utilization of related grid operations and resources, with cost-effective full cyber security (PT Code 8360)*
    - STAR also establishes a standardized system where industry best practices and algorithms can be shared within the utility community.

- Adoption of EPIC technology, strategy and research data/results by others
  - EPIC project results referenced in regulatory proceedings and policy reports

6.3 Plans for Deployment

- STAR Plan/Analyze Phase – Determine the functionality, user-interface, architecture and other requirements for a full STAR production system.
- STAR Phase 1 – Implement the functionality defined during the plan/analyze phase for TBD Transmission and Distribution asset classes
- STAR Phase 2 (and beyond): Implement the STAR tool for other electric Transmission and Distribution system assets. Also refine and upgrade functionality as appropriate.

STAR will enable PG&E to manage risk in a transparent manner through consistent application of risk formulae, as well as supporting the creation of asset projects, linking projects to the risk elements associated with assets. It is envisioned that STAR has the potential to leverage financial data as it relates to maintaining or replacing assets, linking analysis of asset investment to asset survival rates. Some of this functionality will be sought in the near term, with the rest considered at a later time. A future STAR production solution would be developed using General Rate Case (GRC) funding.

7.0 Appendix

7.1 Data Source details

The table provides system names, descriptions, version during POC and format of the data extraction.

Table 4
Data Source Details

System	Description	App/DB Versions	Data Extract File Format
Electric Distribution Geographic Information System (ED GIS)	Distribution Geospatial system including network connectivity model	ESRI 10.1 Oracle Spatial	Database export: Oracle 11g Geospatial attributes: Native ArcGIS, or Oracle SDO
Land Base Geographic Information System (LB GIS)	Land Base Geospatial System	ESRI 10.1 Oracle Spatial	Shape file
ERP (Financials, Supply Chain, Work and Asset Management)	SAP Enterprise wide asset management, work management with integrated financials and supply chain system.	SAP ECC6 Oracle 10g	Delimited flat file/s (pipe or .csv)
Outage Database	Repository for outage information such as customer minutes, customer interruptions, number of sustained outages, etc.	Note: CEDSA migrating to ED GIS and Outage Database Re-Write Ventyx FocalPoint 6.6.5 Oracle 11g	Excel file

System	Description	App/DB Versions	Data Extract File Format
ASPEN Oneliner	Transformer replacement list and bus fault duty.	Oneliner 11 Oracle 10	Excel file
CYME	Distribution lines and ratings	CYMDIST 7.1 r2 Oracle 10g	Access database
Splices	Inventory of Primary Overhead Conductor splice locations.	Excel	Excel file
Delta-X	Substation and transformer conditions from DGA analysis and oil quality	Excel	Excel file
BRKR-D Replacement List	Source of SAP Equipment ID	Excel	Excel file
Central Valley Region Substations and Feeders	In scope substations	Excel	Excel file
High Failure Rate Make and Model	High failure risk for make and model combination	Excel	Excel file
TXFR-D Replacement List	Source of SAP Equipment ID	Excel	Excel file

7.2 POC Evaluation Criteria

The POC Evaluation Criteria table provides the list of criteria and their description used for the STAR POC evaluation. The criteria are categorized as Company, Software Quality, Implementation Ability or Product Usability.

Table 5
POC Evaluation Criteria

Criteria	Description
Software Quality	
Performance	How does the performance of the software seen during the prototype compare with your expectations? If you're aware of other customer's performance experience; consider those. Perspectives include end user and IT.
Reliability	How reliable has the software been during the prototype as far as accessibility and errors? If you're aware of other customer's reliability experience; consider those.
Visualization	How is the user experience from an aesthetic point of view?
Analytics (algorithms)	Ability to ingest data, apply algorithms and display results for the purpose of risk analysis.
Maintainability	How easily do you think the software can be maintained when changes such as algorithms, work processes and source databases occur?
Interoperability	How easily does this software integrate with other systems? Consider all of the potential datasets such as GIS, SAP, Outage, Engineering, etc.
Functionality	Is the out of the box functionality along with customization capability there to meet your requirements?
Implementation Ability (Vendor Resources)	
Customize Functionality	How effective have the vendor resources been on customizing functionality in STAR?
Customize Usability	How effective have the vendor resources been on customizing the user experience in STAR?
Ingesting Source Data	How effective have the vendor resources been on integrating multiple datasets into STAR? Also includes the ability to bring in non PG&E data for risk analysis.
Timeliness	How well did the vendor team perform in regards the STAR schedule?
Project Management	Detail Agile PM effectiveness.
Communication	Explain the application, processes, interact with PG&E team.
Meet Requirements	Did the vendor meet the original functional requirements and craft the user stories to meet PG&E's needs for STAR?
Training	How well did the vendor conduct the user training? How effective was it?
Product Usability	
Understandability	Is the STAR application understandable and easy to navigate?
Translation of Business Processes	How effectively can this product produce productive business processes?
Documentation	How complete and usable is the STAR application documentation?
Learnability	How easily can users learn the application? Is it intuitive?

7.3 Algorithms

Core to the STAR tool is the handling of risk algorithms relating to both individual and aggregated assets within the Electric Operations line of business. The risk algorithms incorporate elements of both probability of failure and severity of failure. The STAR tool supports the risk calculation based on existing algorithms, but also facilitates testing and creation of new algorithms based on statistical analyses of data, as well as evolution of algorithms as new data sources become available.

7.3.1 Distribution Substation Transformer Risk Score Calculation

The following steps walk through risk score calculation for distribution substation transformers.

Figure 5
High Level Step-By-Step Risk Score Calculations for Distribution Substation Transformers

1 Calculate the 1-7 Safety, Reliability and Environmental Impact

2 Calculate the 1-7 frequency score

3 Calculate the $RS_{safety(S)}$, $RS_{environmental(E)}$ and $RS_{reliability(R)}$

$$RS_{S,E,R} = k^{[0.5\ \mathrm{Log}(f_{S,E,R})+I_{S,E,R}]}$$

where: f = the number of occurrences expected over a one year time horizon
and I is the impact of the event
and k is the scalar and is a fixed number of 3.16227766017085
and 0.5 is the standard risk reduction factor for aggregating the impact of uncorrelated occurrences

And $f_{S,E,R} = \frac{1}{T_{S,E,R}}$ where

Frequency Score (RIBA)	T (# Years)
1	1000
2	100
3	30
4	10
4.5	5
5	3.33333
6	0.1
7	0.01

4 Calculate the Total Risk Score

$$RS_{Total} = RS_{Safety(S)} + RS_{Environmental(E)} + RS_{Reliability(R)}$$

The determination of the 1-7 Safety, Reliability and Environmental impact and frequency scores (steps 1, 2) is below:

Reliability: The impact dimension for reliability is determined based on the number of customers served by the individual substation transformer. The calculation for the reliability impact score is:

$$Reliability\ Impact\ Score\ (R_I) = LOG(\#Customers) + 1$$

The frequency dimension for reliability is determined based on a weighted average score of several asset attributes. Each attribute is scored based on a range from 0-20. The asset attributes and their individual weightings are as follows:

Table 6
Reliability Score Details

Attribute	Value	Weight (W_i)
Age	0-20 Score	25.8%
DGA/Oil Quality	0-20 Score	51.6%
Through Fault	0-20 Score	12.9%
Top 5 worst transformer in HQ	0-20 Score	9.7%

Each attribute score is determined as follows:

Age

Table 7
Transformer Age Range Values

Age Range	1 Phase Value	3 Phase Value
0 ≤ Age ≤ 5	1	1
6 ≤ Age ≤ 10	2	3
11 ≤ Age ≤ 15	3	5
16 ≤ Age ≤ 20	4	7
21 ≤ Age ≤ 25	6	10
26 ≤ Age ≤ 30	8	12
31 ≤ Age ≤ 35	10	14
36 ≤ Age ≤ 40	12	16
41 ≤ Age ≤ 45	14	18
46 ≤ Age ≤ 50	15	20
51 ≤ Age ≤ 55	16	20
56 ≤ Age ≤ 60	17	20
61 ≤ Age ≤ 65	18	20
66 ≤ Age ≤ 70	19	20
Age > 70	20	20

DGA/Oil Quality

Table 8
DGA/Oil Quality Values

DGA Score	Oil Score	Attribute Value (0-20)
1	1-2	0
1	3	5
1	4	10
2	1	0
2	2	3
2	3	5
2	4	10
3	1-3	15
3	4	20
4	1-4	20

Through-Fault

$$Through\ Fault\ Score = Min\left[\frac{Fault\ Duty_{Max}}{1000},\ 20\right]$$

Top 5 worst transformer in HQ

Table 9
Worst Transformer Values

Top 5 Worst?	Attribute Value$_j$ (0-20)
No	0
Yes	20

Once the attribute score is calculated for each attribute, the overall health index for the reliability frequency score is determined as follows:

$$Health\ Index\ (HI) = \sum_{j=1}^{n} W_j * Attribute\ Value_j$$

Once the health index is calculated, the overall frequency dimension is determined based on a mapping from the health index score

Table 10
Health Index Score

Health Index (HI)	Frequency Score
HI > 16	7
14 ≤ HI < 16	6
10 ≤ HI < 14	5

7 ≤ HI < 10	4
HI < 7	3

Safety: All distribution substation transformers received a safety impact score of 1 and a safety frequency of 1.

The safety impact score of 1 was determined because: although the worst case scenario of a catastrophic failure of a substation transformer bank causing fatalities and injuries is a rare possibility, the worst reasonable direct impact of an injury/fatality during a catastrophic bank failure is low. Any scenario involving such a fatality most likely would involve the failure of a protection device which could not be mitigated by replacing the transformer

The safety frequency score of 1 was determined because: a) protection schemes are designed to de-energize the bank prior to failure; b) banks are occasionally forced out of service to avoid an in-service failure; and c) the likelihood of an employee or a 3rd party close enough to a bank during an event of this magnitude is rare.

Environmental: All distribution substation transformers received an environmental impact of 2 based on the possibility of a small, locally contained oil leak.

The environmental frequency score is determined based on the age of the transformer. It is determined that older transformers have a higher probability of an oil leak. The frequency score of transformers greater than 40 years old is a 4, and the frequency score of transformers equal to, or younger than 40 years old is a 3.

7.3.2 Distribution Substation Breaker Risk Score Calculation

The following steps walk through risk score calculation for distribution substation transformers.

Figure 6
High Level Step-By-Step Risk Score Calculations for Distribution Substation Breakers

1. Calculate the 1-7 Safety, Reliability and Environmental Impact

2. Calculate the Safety, Reliability and Environmental frequency scores

3. Calculate the $RS_{safety(S)}$, $RS_{environmental(E)}$ and $RS_{reliability(R)}$

$$RS_{S,E,R} = k^{[0.5\ \mathrm{Log}(f_{S,E,R})+I_{S,E,R}]}$$

where: f = the number of occurrences expected over a one year time horizon
and I is the impact of the event
and k is the scalar and is a fixed number of 3.16227766017085
and 0.5 is the standard risk reduction factor for aggregating the impact of uncorrelated occurrences

And $f_{S,E,=\frac{1}{T_{S,E}}}$ where

And $f_{R=Adjusted\ Probability\ of\ Replacement}$

Frequency Score (RIBA)	T (# Years)
1	1000
2	100
3	30
4	10
4.5	5
5	3.33333
6	0.1
7	0.01

4. Calculate the Total Risk Score

$$RS_{Total} = RS_{Safety(S)} + RS_{Environmental(E)} + RS_{Reliability(R)}$$

The determination of the 1-7 Safety, Reliability and Environmental impact and frequency scores (steps 1, 2) is below:

Reliability: The impact dimension for reliability is determined based on the number of customers served off the individual substation breaker. The calculation for the reliability impact score is:

$$Reliability\ Impact\ Score\ (R_I) = LOG(\#Customers) + 1$$

The frequency dimension for reliability is determined based on a Probability of Replacement curve adjusted by a multiplier determined by the % overstressed of the breaker

The first step to calculate the breaker frequency is to look up the initial probability of replacement calculated based on fleet performance.

Once we have the probability of replacement, we apply a multiplier depending on whether or not the breaker is overstressed such that

$$f_{R,Final} = f_{R,Initial} * Overstressed\ Multiplier$$

The multiplier is determined as follows:

Table 11
Overstressed Multiplier

% Overstressed	Overstressed Multiplier

% Overstressed > 100%	% Overstressed
% Overstressed ≤ 100%	1

For example, a 40 year old breaker with a probability of replacement per year of 1% and % overstressed = 123% has an
$f_{R,Final}$ = 1.23% = 1% * 123%

Safety: The impact dimension for substation breakers is determined by the fault current using the following table:

Table 12
Overstressed Percentage

% Overstressed	Safety Impact Score
%Overstressed ≥ 125%	4
% Overstressed < 125%	1

All distribution substation breakers received a safety frequency of 1.

The safety frequency score of 1 was determined because: Although the worst case scenario of a catastrophic failure of a substation circuit breaker causing fatalities and injuries is possible, the probability of an injury/fatality during a catastrophic circuit breaker failure is very low.

Environmental: The environmental impact score was determined based on the circuit breakers insulation medium. The impact score was determined as follows:

Table 13
Insulation Medium - Impact

% Overstressed	Environmental Impact Score
Oil, PCB ≥ 50 PPM	5
Oil, PCB < 50 PPM	2
SF_6 Gas	2
Vacuum	1

The environmental frequency score is determined based on the insulation medium as follows:

Table 14
Insulation Medium - Frequency

% Overstressed	Environmental Frequency Score
Oil	3
SF_6 Gas	3
Vacuum	1

7.3.3 Distribution OH Primary Conductor Risk Score Calculation

The following steps walk through risk score calculation for distribution substation transformers.

Figure 5
High Level Step-By-Step Risk Score Calculations for Distribution OH Primary Conductor

1. Calculate the 1-7 Safety, Reliability and Environmental Impact

2. Calculate the 1-7 frequency score

3. Calculate the $RS_{safety(S)}$, $RS_{environmental(E)}$ and $RS_{reliability(R)}$

$$RS_{S,E,R} = k^{[0.5\ \mathrm{Log}(f_{S,E,R})+I_{S,E,R}]}$$

where: f = the number of occurrences expected over a one year time horizon
and I is the impact of the event
and k is the scalar and is a fixed number of 3.16227766017085
and 0.5 is the standard risk reduction factor for aggregating the impact of uncorrelated occurrences

And $f_{S,E,R} = \frac{1}{T_{S,E,R}}$ where

Frequency Score (RIBA)	T (# Years)
1	1000
2	100
3	30
4	10
4.5	5
5	3.33333
6	0.1
7	0.01

4. Calculate the Total Risk Score

$$RS_{Total} = RS_{Safety(S)} + RS_{Environmental(E)} + RS_{Reliability(R)}$$

The determination of the 1-7 Safety, Reliability and Environmental impact and frequency scores (steps 1, 2) is below:

Reliability: The impact dimension for reliability is determined based on the number of customers served by the upstream protective device associated with the conductor line section. The calculation for the reliability impact score is:

$$Reliability\ Impact\ Score\ (R_I) = LOG(\#Customers) + 1$$

The frequency dimension for reliability is determined based on a health index calculation as follows:

Table 15
Reliability Frequency Score

Health Index (HI)	Reliability Frequency Score
HI = 1	7

0.95 ≤ HI < 1	6
0.90 ≤ HI < 0.95	5
0.80 ≤ HI < 0.90	4.5
0.65 ≤ HI < 0.80	4
0.50 ≤ HI < 0.65	3
0.25 ≤ HI < 0.50	2
HI < 0.25	1

The health index calculation is a weighted average score of several asset attributes. Each attribute is scored based on a range from 0-1. The asset attributes and their individual weightings are as follows:

Table 16
Reliability Score Details

Attribute	Value	Weight (W_i)
Age	0-1 Score See appendix (slide 9)	15%
Wire Size and Type	Normalized score (0-1) See appendix (slide 10-12)	20%
Load Current (greater than conductor rating)	Yes/No (Yes - 1, No - 0)	10%
Fault Duty (exceeding I^2t)	Yes/No (Yes - 1, No - 0)	15%
Number of splices	Thresholds See appendix (slide 13)	20%
Wind zone	Yes/No	5%
Corrosion areas	Yes/No (Yes - 1, No - 0)	15%

Each attribute score is determined as follows:

Age:
Step 1: Calculate the age for each individual line section using the following:

Table 17
OH Conductor Age Calculation

OH Install Date	Age Calculation
Install Year > Current Year	Use average line transformer age as proxy
Install Date > 1990	Use EDGIS Age data
1986 ≤ Install Date ≤ 1990	Use average line transformer age as proxy
Install Date < 1986	Use EDGIS Age data
Install Date = 1900	Use average line transformer age as proxy

Step 2: Quartile the results and assign a 0-1 score using the following:

Table 18
OH Conductor Age Quartile

Age Quartile	0-1 Score
Quartile 1 (Oldest)	1
Quartile 2	0.66
Quartile 3	0.33
Quartile 4 (Youngest)	0

Wire Size and Type:

Wire-Down site visit results were combined with wire-down metric results and system inventory to obtain wire-down rates per 100 miles. These rates were used to extrapolate a 0-1 score for all wire size and types in the system. The 0-1 score was determined based on the wire size and type using the following table:

Table 19
Wire Size and Type

Type	Wire Size	Final Score (0-1)
ACSR	3/0	0
ACSR	4	0.403846
ACSR	2	0
ACSR	1/0	0
ACSR	4/0	0
ACSR	267	0
ACSR	397	0
ACSR	795	0
ACSR	1113	0
ACSS	477	0
Aluminum	1/0	0.211538
Aluminum	3/0	0.211538
Aluminum	4/0	0.211538
Aluminum	267	0.211538
Aluminum	336	0.211538
Aluminum	397	0.134615
Aluminum	715	0.134615
Aluminum	954	0.134615
Aluminum	1113	0.134615
Copper	8	0.865385
Copper	6	1
Copper	4	0.865385
Copper	2	0.413462
Copper	1	0.413462
Copper	1/0	0.384615
Copper	2/0	0.384615
Copper	3/0	0.384615
Copper	4/0	0.384615

Copper	250	0.384615
Copper	500	0.384615
Copper	750	0.384615
Copper	4	0.865385
Copperweld	8A	0.865385
Copperweld	6A	0.865385
Copperweld	4A	0.865385
Copperweld	2A	0.865385
Copperweld	1F	0.865385

Load Current:
If the load current was greater than the conductor rating, a score of 1 was given. If the load current was not greater than the conductor rating, a score of 0 was given.

Fault Duty:
If the fault duty exceeds I^2t for a given line section a score of 1 was given, If not than a score of 0 was given.

Number of Splices:
The 0-1 score was determined based on the max number of splices in an individual phase according to the following table:

Table 20
Splice Count

Max Number of Splices in individual phase	0-1 Score
>10	1
9	0.85
8	0.7
7	0.55
6	0.40
5	0.30
4	0.20
3	0.1
< 3	0

Wind Zone:
If the line section was in a high wind zone, a score of 1 was given, if not, a score of 0 was given

Corrosion Areas:
If the line section was in corrosion zone, a score of 1 was given, if not, a score of 0 was given

Safety:
The safety impact dimension for OH Primary Conductor is a 6. A failure of an OH Primary conductor may result in public/employee fatality

The safety frequency dimension was determined based on the population density according to the following table:

Table 21
Population Density

Population Density	Safety Frequency Score
High urban area (Pop density > 1000 per sq. mile)	2
Medium/low urban area (Pop density < 1000 per sq. mile)	1

Environmental:
The environmental impact dimension for OH Primary Conductor is determined based on the possibility of starting a localized fire. For the POC, all OH Primary Conductors were given an environmental impact score of 3

All OH Primary conductors received an environmental frequency score of 1.

7.3.4 Distribution Wood Pole Risk Score Calculation

The following steps walk through risk score calculation for distribution wood poles.

Figure 6
High Level Step-By-Step Risk Score Calculations for Distribution Substation Breakers

1 Calculate the 1-7 Safety, Reliability and Environmental Impact

3 Calculate the 1-7 frequency score

4 Calculate the $RS_{safety(S)}$, $RS_{environmental(E)}$ and $RS_{reliability(R)}$

$$RS_{S,E,R} = k^{[0.5\ \mathrm{Log}(f_{S,E,R})+I_{S,E,R}]}$$

where: f = the number of occurrences expected over a one year time horizon
and I is the impact of the event
and k is the scalar and is a fixed number of 3.16227766017085
and 0.5 is the standard risk reduction factor for aggregating the impact of uncorrelated occurrences

And $f_{S,E,=\frac{1}{T_{S,E}}}$ where

And $f_{R=Final\ Reject\ Rate\ (RR_{Final})}$

Frequency Score (RIBA)	T (# Years)
1	1000
2	100
3	30
4	10
4.5	5
5	3.33333
6	0.1
7	0.01

5 Calculate the Total Risk Score

$$RS_{Total} = RS_{Safety(S)} + RS_{Environmental(E)} + RS_{Reliability(R)}$$

The determination of the 1-7 Safety, Reliability and Environmental impact and frequency scores (steps 1,2) is below:

Reliability: The impact dimension for reliability is determined based on the number of customers served by the upstream protective device associated with the conductor line section. The calculation for the reliability impact score is:

$$Reliability\ Impact\ Score\ (R_I) = LOG(\#Customers) + 1$$

The frequency dimension for reliability is determined based on a Reject Rate curve adjusted by a multiplier determined by the % Pole Strength of the pole

The frequency dimension for reliability is determined based on a reject rate:

Table 22
Reject Rate

Final Reject Rate (RR_{Final})	Reliability Impact Score
$RR_{Final} > 100\%$	6
$30\% < RR_{Final} \leq 100\%$	5
$20\% < RR_{Final} \leq 30\%$	4.5
$10\% < RR_{Final} \leq 20\%$	4
$3.3\% < RR_{Final} \leq 10\%$	3
$1\% < RR_{Final} \leq 3.3\%$	2
$RR_{Final} \leq 1\%$	1

Where the reject rate is determined as follows:

$$RR_{Final} = RR_{Initial} * RR_{multiplier}$$

The initial reject rate is measured based on the poles age, species and division attributes

Once we have the initial reject rate, we calculate the resulting safety factor (reject rate multiplier) by attributes

$$SF_{Resulting} = \%\ Pole\ Strength$$

Where:

$$\%\ Pole\ Strength = 1 - \left[1 - \left(2 * Shell\ Thickness * \frac{\pi}{Current\ Circumference}\right)\right]^4$$

If we have a measured value of the shell thickness, or:

$$\%\ Pole\ Strength = \frac{(Current\ Circumference)^3}{(Orignical\ Circumference)^3}$$

If we only know the current and original circumference

The multiplier is determined as follows:

Table 23
Safety Factor Multiplier

Resulting Safety Factor ($SF_{resulting}$)	Reject Rate Multiplier ($RR_{multiplier}$)
$SF_{resulting} \geq 100\%$	1
$SF_{resulting} < 100\%$	2

Safety: The safety impact dimension for all distribution wood poles is a 6. A failure of a wood pole may result in public/employee injury

The safety frequency dimension was determined based on the population density according to the following table:

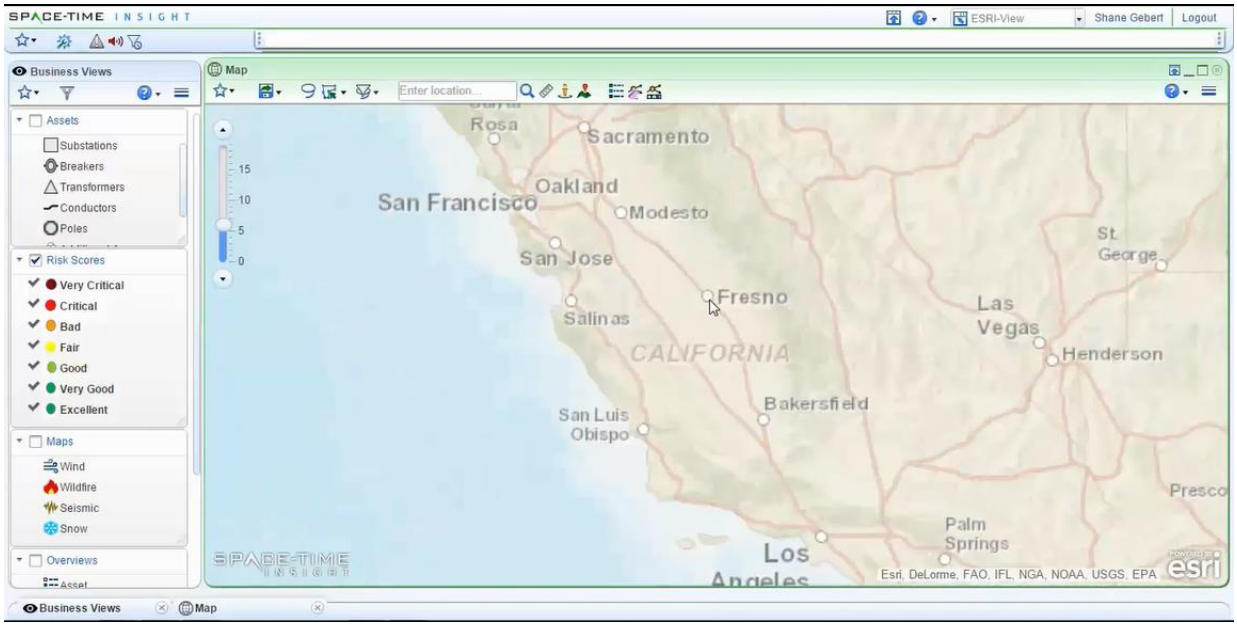
Table 24
Population Density

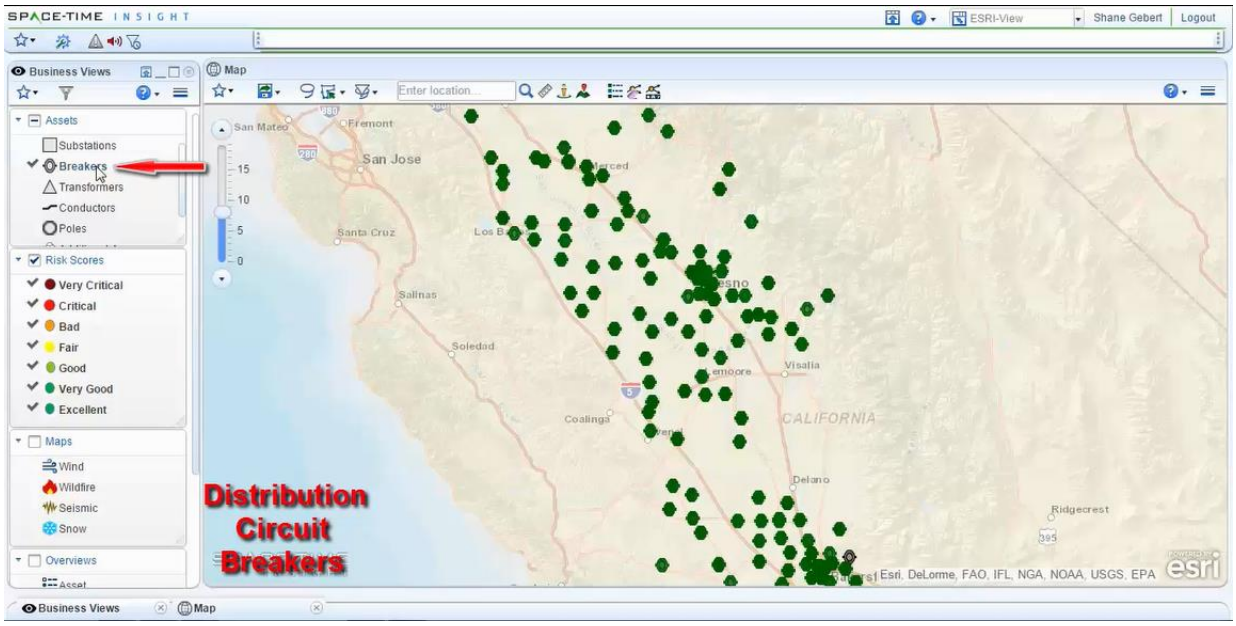
Population Density	Safety Frequency Score
High urban area (Pop density > 1000 per sq. mile)	2
Medium/low urban area (Pop density < 1000 per sq. mile)	1

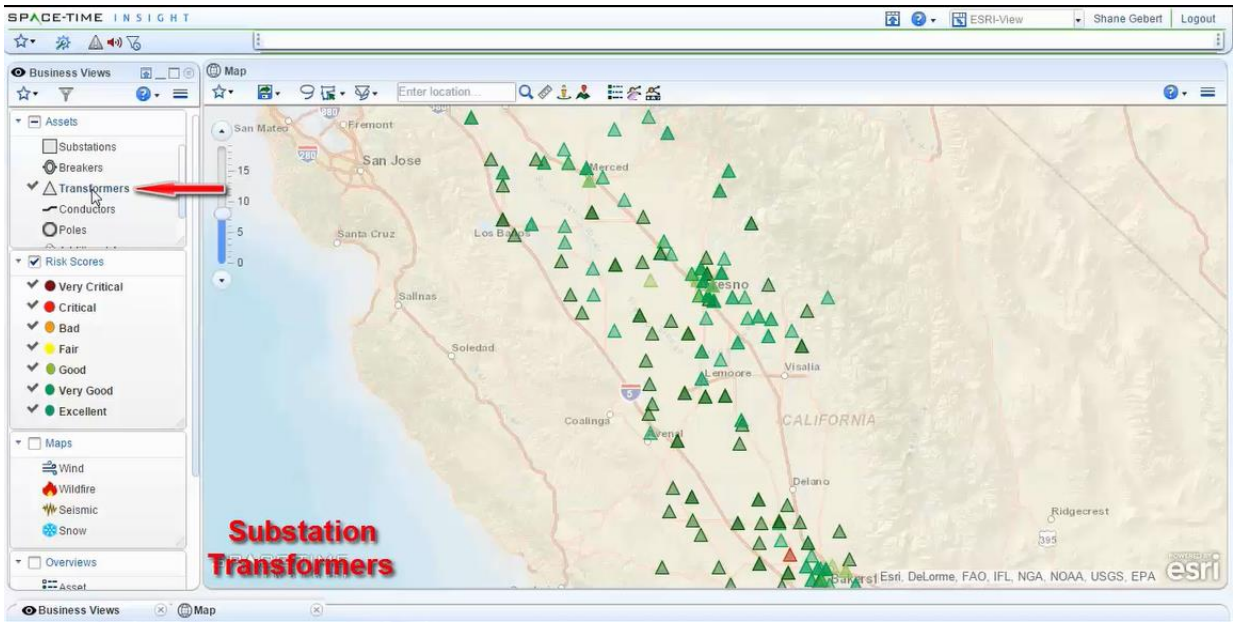
Environmental: The environmental impact dimension for distribution wood poles is determined based on the possibility of starting a localized fire. For the POC, all distribution wood poles were given an environmental impact score of 3.

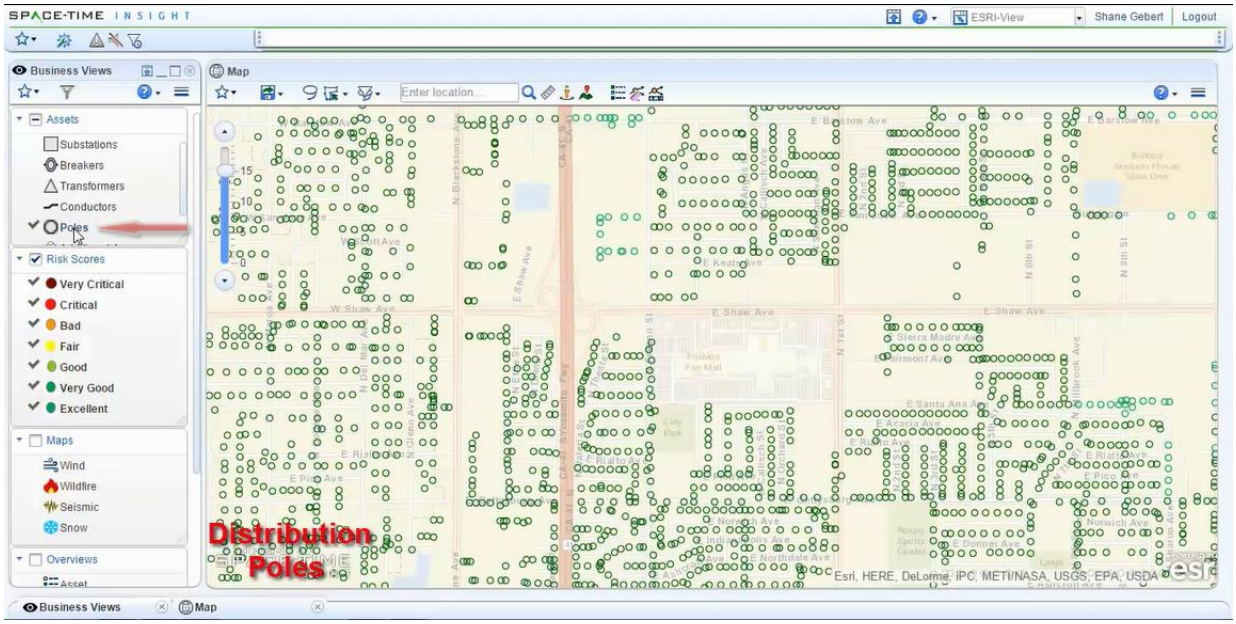
All distribution wood poles received an environmental frequency score of 1.

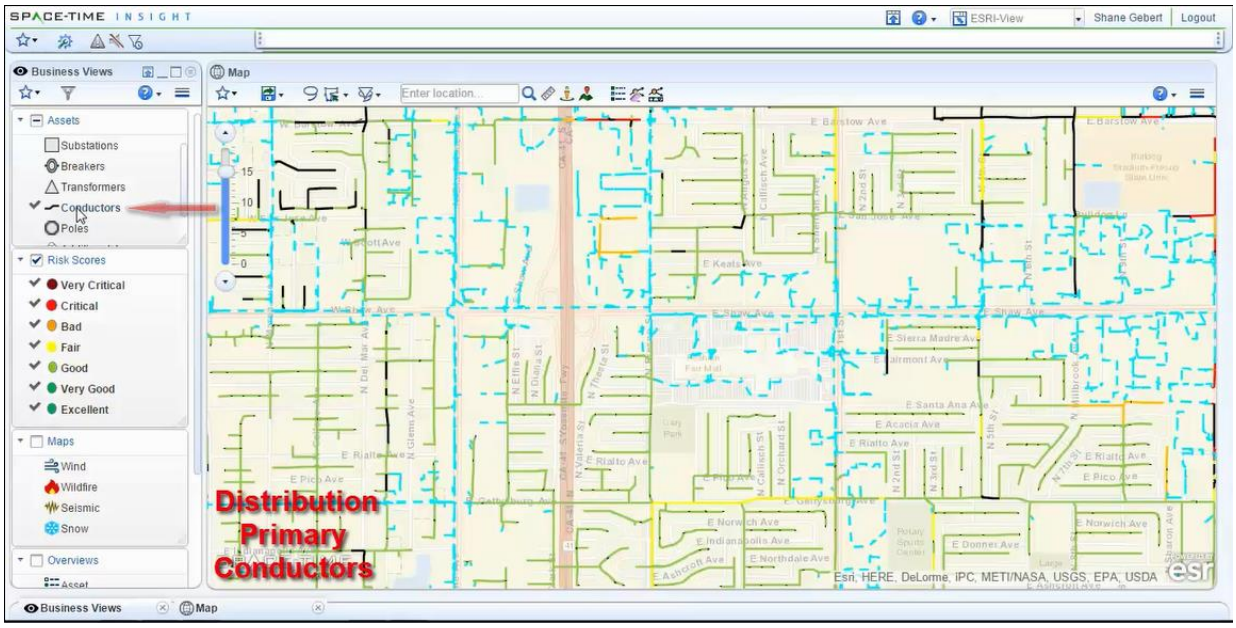
7.4 STAR POC Screenshots

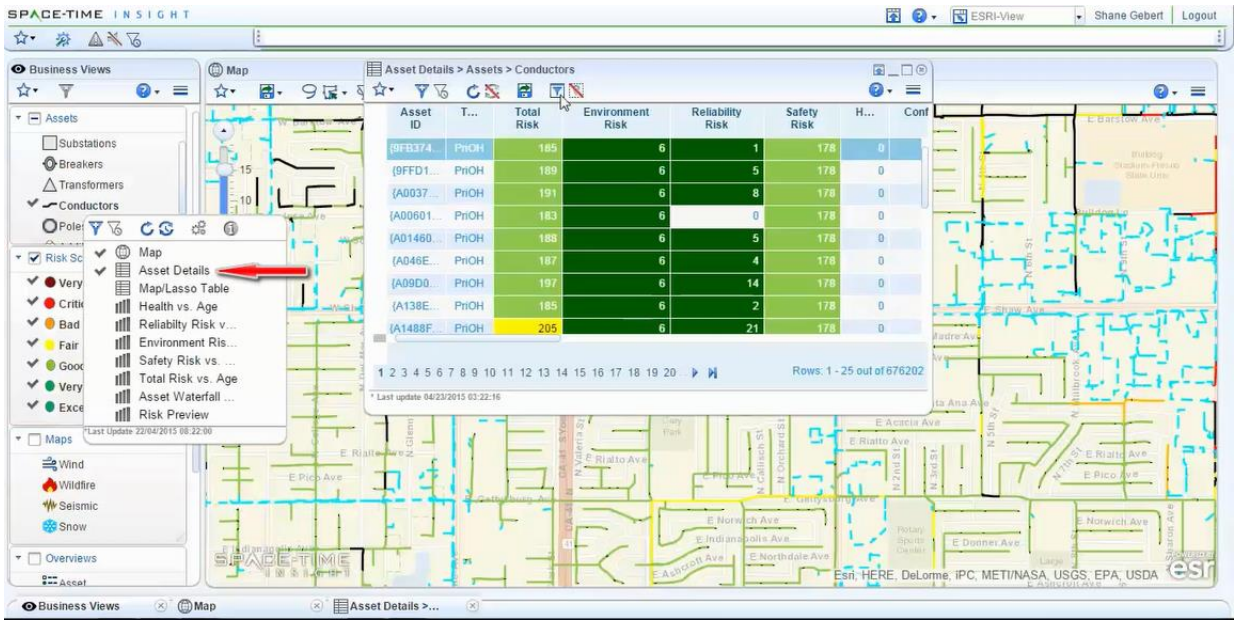


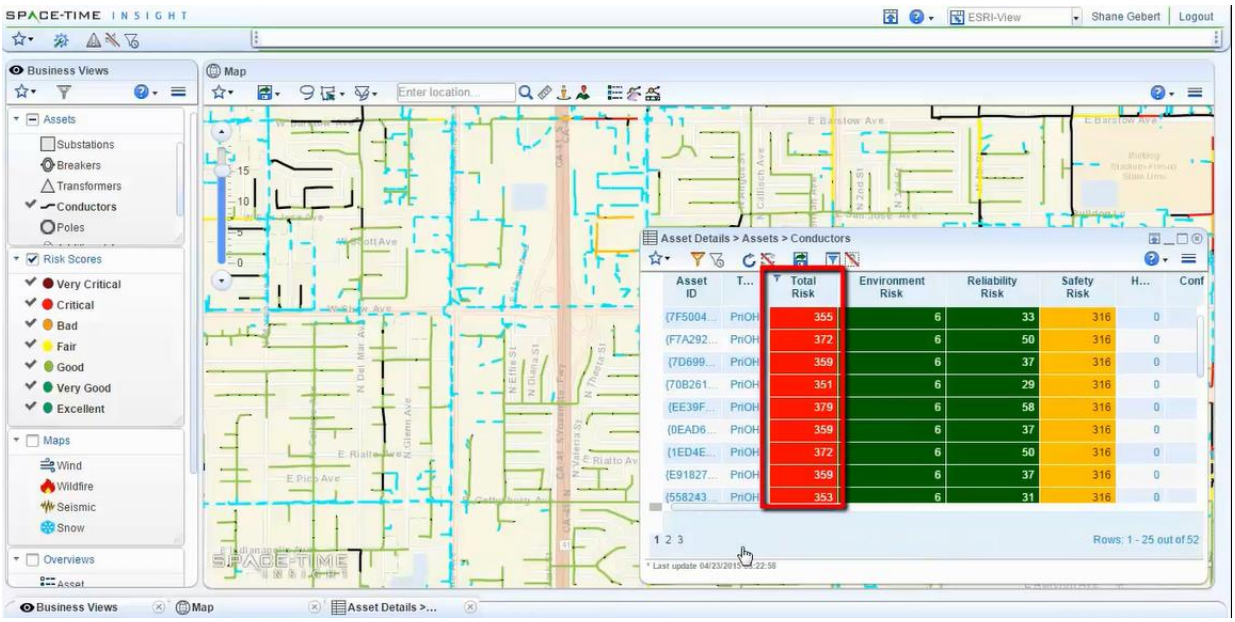



SPACE-TIME INSIGHT
ESRI-View
Shane Gebert
Logout
Business Views
Map
Enter location...
Assets
Substations
Breakers
Transformers
Conductors
Poles
Risk Scores
Very Critical
Critical
Bad
Fair
Good
Very Good
Excellent
Maps
Wind
Wildfire
Seismic
Snow
Overviews
Asset
San Mateo
Fremont
San Jose
Merced
Santa Cruz
Los Banos
Fresno
Salinas
Soledad
Visalia
Lemoore
Coalinga
CALIFORNIA
Delano
Ridgecrest
Substation Transformers
Esri, DeLorme, FAO, IFL, NGA, NOAA, USGS, EPA
esri

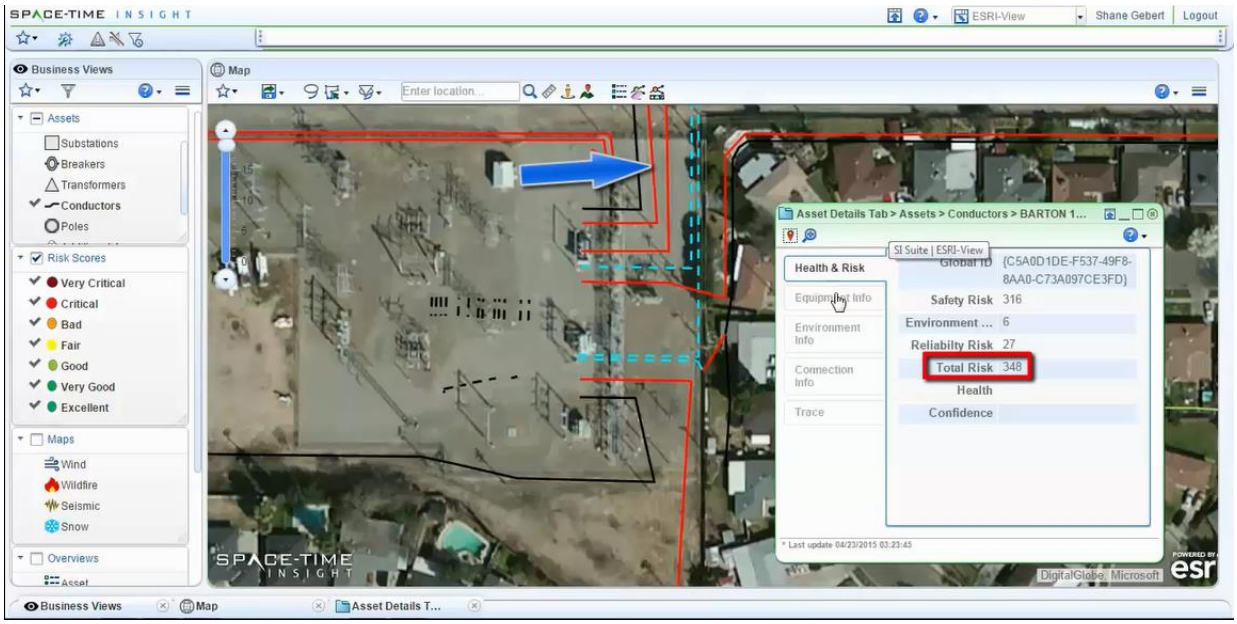

SPACE-TIME INSIGHT
ESRI-View
Shane Gebert
Logout
Business Views
Map
Enter location...
Assets
Substations
Breakers
Transformers
Conductors
Poles
Risk Scores
Very Critical
Critical
Bad
Fair
Good
Very Good
Excellent
Maps
Wind
Wildfire
Seismic
Snow
Overviews
Asset
Distribution Poles
Esri, HERE, DeLorme, IPC, METI/NASA, USGS, EPA, USDA
esri


SPACE-TIME INSIGHT
ESRI-View
Shane Gebert
Logout
Business Views
Map
Assets
Substations
Breakers
Transformers
Conductors
Poles
Risk Scores
Very Critical
Critical
Bad
Fair
Good
Very Good
Excellent
Maps
Wind
Wildfire
Seismic
Snow
Overviews
Distribution Primary Conductors
Esri, HERE, DeLorme, iPC, METI/NASA, USGS, EPA, USDA


SPACE-TIME INSIGHT
ESRI-View
Shane Gebert
Logout
Business Views
Map
Asset Details > Assets > Conductors
Asset ID
T...
Total Risk
Environment Risk
Reliability Risk
Safety Risk
H...
Conf
Map
Asset Details
Map/Lasso Table
Health vs. Age
Reliability Risk v...
Environment Ris...
Safety Risk vs. ...
Total Risk vs. Age
Asset Waterfall ...
Risk Preview
Rows: 1 - 25 out of 676202
Esri, HERE, DeLorme, iPC, METI/NASA, USGS, EPA, USDA


SPACE-TIME INSIGHT
ESRI-View
Shane Gebert
Logout
Business Views
Map
Assets
Substations
Breakers
Transformers
Conductors
Poles
Risk Scores
Very Critical
Critical
Bad
Fair
Good
Very Good
Excellent
Maps
Wind
Wildfire
Seismic
Snow
Overviews
Asset Details > Assets > Conductors
Asset ID
Total Risk
Environment Risk
Reliability Risk
Safety Risk
Rows: 1 - 25 out of 52


SPACE-TIME INSIGHT
ESRI-View
Shane Gebert
Logout
Business Views
Map
Map Settings
Base Maps
Map Type
Imagery
Opacity
Esri Layers
WorldTimeZones
USA
World Boundaries and Places Alternate
World Reference Overlay
World Transportation
Mean Annual Temperature
Esri Overlay Features
Navigation Control
Scale Legend
Imported kml/kmz
General Settings
DigitalGlobe, Microsoft
esri


SPACE-TIME INSIGHT
ESRI-View
Shane Gebert
Logout
Business Views
Map
Enter location...
Assets
Substations
Breakers
Transformers
Conductors
Poles
Risk Scores
Very Critical
Critical
Bad
Fair
Good
Very Good
Excellent
Maps
Wind
Wildfire
Seismic
Snow
Overviews
Asset Details Tab > Assets > Conductors > BARTON 1...
SI Suite | ESRI-View
Health & Risk
Equipment Info
Environment Info
Connection Info
Trace
Global ID
{C5A0D1DE-F537-49F8-8AA0-C73A097CE3FD}
Safety Risk 316
Environment ... 6
Reliabilty Risk 27
Total Risk 348
Health
Confidence
DigitalGlobe, Microsoft
esri
Business Views
Map
Asset Details T...